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PROF. HARTT ON THE BRAZILIAN SANDSTONE REEFS.

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THE sea-coast of Brazil, from the mouth of the Amazonas to near Victoria, is generally low and of quite uniform character, being everywhere faced with broad, open beaches of sand that extend for miles and miles without interruption. A less inviting region than this to the explorer can scarcely be imagined, and it stands in marked contrast with the more tempting inland districts, especially those in the Amazonian valley, which have always caused Brazil to be considered a sort of naturalists' paradise. It was little suspected, until a few years ago, that this unattractive coast harbored very extensive and curious coral reefs, and displayed, in connection with its beaches, interesting phenomena whose true character had been entirely misunderstood.

Some of the earlier writers on Brazil endeavored to describe this region, relying either on their own imperfect observations, or on what others had seen, and adding, apparently, here and there, numerous details, the products of their own fertile brains, perhaps, to smooth over and complete the sketch.

These very inaccurate accounts gave credence to the existence of a long bar or reef of stone, bordering the entire coast from north of Cape St. Roque to the southward of Bahia. Piso, in his work published in 1648, described this reef, and he has been copied over and over again by nearly every author who has written on this subject since his time, no one ever having taken the trouble to test the accuracy of his statements. Even Staff-Commander Penn, in the "South American Coast Pilot,"

treats of "the *recife*, a singular ridge of coral rock," bordering the coast, at a distance from it of about half a mile to three miles or more, and extending from the north-east part of Brazil to south of Bahia. According to his accounts, the reef is about sixteen feet broad at the top, forming a natural breakwater, with smooth and shallow water inside, affording a channel for coasters. "It is broken occasionally, and forms, by the openings, entrances to the greater part of the ports, rivers and creeks on the coast."

Gardner describes the mythical reef in nearly the same terms, and there can be no doubting the fact that these two writers have reproduced Piso's old description, with many additional details thrown in gratuitously.

It is needless to state that these accounts of a continuous reef were without foundation, but they served, more or less, to mould the world's ideas of the character of that coast up to the time when the late Prof. Ch. Fred. Hartt published the results of his careful and painstaking explorations of that region. Whether this observer was the first to rightly interpret the structure of the Central Brazilian coast or not, he, at least, has given the only extended and intelligible account of it. He has shown that although stone reefs occur at many localities, they are far from being universal, or even continuous over any great distance.

Quite distinct from these are a series of coral reefs, often lying near the shore, but much more developed farther out, rising upward from the surface of the submerged border of the continent.

As a member of the Thayer Expedition in 1865, Prof. Hartt examined two quite perfect stone reefs, at Porto Seguro and Santa Cruz, in the province of Bahia, and at several places in the province of Espirito Santo he also found traces of the same structure, lying near the beach, however, and not forming true reefs. On his second trip, in 1867, he was able to study the larger and more perfect stone reef of Pernambuco, and to detect a similar formation on the beaches about Bahia. A full statement of these investigations, and of his theory of the origin of the reefs, is given in his "Geology and Physical Geography of Brazil," published in 1870. Darwin, who touched at Pernambuco on his memorable voyage, arrived at nearly the same conclusions regarding the mode of formation of the reef at that place, as did Prof. Hartt, but his description of it is very brief.

Immediately upon the organization of the Geological Commission of Brazil, in 1875, under the leadership of Prof. Hartt, active field operations were commenced in the province of Pernambuco, and another opportunity was thus afforded the late chief to examine that most noted of all these natural breakwaters. With the larger force and more perfect appliances now at his command, he proceeded to carefully map out the reef and its surroundings, and to study in detail every feature connected with it. This extended investigation did not materially alter his previously-formed ideas as to the true character and mode of growth of the reef, but there were added many facts not before observed.

Other stone reefs, at Cape Sto-Agostinho, Parahyba do Norte, etc., were explored by the Commission, and the conclusions arrived at, after comparing the results of all these studies, are of great interest and importance, demonstrating that on the coast of Brazil conditions obtain for the united working of a set of simple forces which, apparently, are not perfectly combined, at least with the same results, in any other part of the world. As we can best understand these phenomena after becoming acquainted with the structure and appearance of a single reef, we will first describe the one at Pernambuco, partly in the very words of Prof. Hartt, and then discuss the subject as a whole.

Just to the south of the city of Pernambuco, a little river breaks through the land, and would open directly into the sea were it not that a narrow wall of stone, running in a general way parallel to the shore, carries its course some distance farther north, to beyond the limits of the city. Another small river, near its mouth flowing parallel with the sea, and separated from it by only a narrow strip of land, runs through the city of Pernambuco, and opens also behind the reef.

There is thus formed a small and very shallow bay, which is continued northward past the city, as a rather narrow channel, having a width of only a hundred rods or less, and a depth of but a few fathoms. The outlet to this channel is close to the northern end of the reef, and is so shallow as to admit only coasting steamers and vessels of ordinary draught. It is, however, the protecting reef and not the narrow harbor that interests us now.

Standing upon some prominent point near the shore, in Pernambuco, we can plainly trace this narrow strip of stone from its commencement, about opposite the ancient fortaleza do Brum,

situated to the north of the city, to the Ilha dos Pinhos, at the south. Its course is south, a few degrees west, and it runs in a nearly straight and unbroken line to near the latter place, where, however, it is cut through so as to afford a passage-way for small boats and jangadas. From this point to its southern end it is much broken up and generally irregular.

But to examine it the more closely we must land upon it at low tide, and walk along its nearly level surface, stopping at times to investigate any unusual appearance that may attract our attention.

The reef rock is a sandstone, of a light brownish tint when wet by the waves, and is formed of siliceous sand and rounded pebbles, mingled with which are many perfect and broken shells, all firmly cemented together by carbonate of lime. The most abundant shell in the sandstone is a species of Venus, still very common on the neighboring shores, and preserving in the rock its natural colors.

At its northern end the reef is very narrow and has, apparently, been much undermined and worn by the waves, for it is lower here than to the south, and the sandstone lies in immense blocks, inclined toward the sea. To increase its height and better protect the harbor at this place, an artificial wall, partly of brick and mortar, partly of reef stone clamped together, has been constructed. That the reef formerly extended much farther northward is evident from the existence of an isolated mass of reef rock just off the northern end, and of a stretch of submerged reef beyond the channel. Upon the extreme point of the reef stands the Pernambuco light-house, and a short distance from it is a little old octagonal fort, called Picao, built of reef stone, and occupying the entire width of the reef.

Following southward, the reef becomes broader and more level on top, but is still very irregular at the sides. In front of the city it has an average width of about two hundred and fifty feet, and a height equal to about that of high tide, though on account of the great commotion made by the waves at such times, it is impossible to exactly determine this fact. As to the thickness of the reef, it must reach down to below the level of low tide, because the rock is never entirely uncovered by the water.

The highest part of the reef forms a broad belt of varying width, whose axis lies a little to the inside of that of the reef.

From this belt the surface slopes more or less strongly on both sides, but presents quite different characters, resulting from differences in exposure. The outer side of the reef has become very irregular from the constant beating of the surf, and is pierced with innumerable cavities of sea-urchins and thickly overgrown with sea-weeds and calcareous incrustations. The inner side, after a more or less rapid landward slope, breaks down abruptly and irregularly, and often presents an overhanging edge.

The reef is cut up into large blocks by joints or cracks, which, though quite variable in their courses, may be reduced to two general series, one parallel to the axis of the reef, the other transverse to it; but many run obliquely or radiate from a common center, as though the reef at that point had settled down upon a hard underlying spot; sometimes they form a tangled maze. These joints are vertical or highly inclined, and the angular masses resulting from them are likely to be detached, on the outer side of the reef by the force of the waves, and on the inner side by the undermining action of the currents in the harbor. In this manner the margins of the reef have been made very jagged, the outer being the most irregular. On the upper surface of the reef, where there has been no dislocation, the joints tend to widen by the action of the surf and by chemical decomposition. There are thus formed open passages, a foot to a yard or more in width, and with a considerable depth of water. In these we always find a rich collection of marine animals, corals and other polyps predominating.

Now let us inspect more minutely the character of the surface, and the many foreign objects living or growing upon it, which tend either to protect it from wear, or to gradually and surely effect its destruction. As stated above, sea-urchins are burrowing into its outer edge. There is only a single species on the Brazilian coast that is able to excavate in the solid rock; it is the *Echinometra subangularis*, everywhere abundant, and possessed of stout, sharply-pointed spines. On abrupt slopes of the reef, this diligent worker forms rounded holes, having only a slight depth, but where the slope is gradual, the holes are much longer, running either directly inwards, or in a more or less winding way, being sometimes curved or bent upon themselves. They have often a length of four or five feet, and a width of three or four inches, the urchin apparently occupying the lower end of the elongate holes.

Whether the process by which the boring is accomplished, in this special case, is chemical or mechanical, it is very certain that this sea-urchin is able to resort to the latter means at times, for its excavations are common in the trap and gneiss rocks of many parts of the coast.

The sea-urchin holes, enlarged by the action of the surf, give rise to cavities and irregular pools on the surface of the reef, and these are deepened and widened by the dissolving action of the water left stagnant in them at low tide. But nullipores, barnacles and tube-building worms also live upon the surface, in immense numbers, and construct a very hard and durable substance which, to a certain extent, compensates for the loss of material caused by the sea-urchins. The barnacles and worms build up little walls of limestone around the mouths of the holes and between them, keeping them for a time more or less separated and perfect; but these walls are being constantly broken away, together with much of the surrounding material, resulting in the formation, over most of the outer slope of the surface, of a multitude of irregular, shallow pools, whose edges are protected by the same growth of barnacles and worm tubes. Many projecting masses, also capped with the hard limestone coating, are left standing in the pools, and wearing most rapidly below, they produce mushroom-like structures, which are very characteristic of the outer surface. They reach to the same height as the margins of the pools.

Ordinary sea-weeds grow luxuriantly on the outer edge of the reef, but they are of slight importance compared with the calcareous nullipores, which live in the full face of the surf and form, over large areas, a crust of a foot or more in thickness. Thus the barnacles, worm-tubes and nullipores combined, aid very materially in protecting the reef from wear, but the good they do is more than counterbalanced by the harmful action of the waves and sea-urchins, and, unless the latter are in some way exterminated, they will eventually work much mischief to the harbor of Pernambuco.

The inner slope of the surface of the reef differs from the outer, in not possessing those features which result from the actions of the sea-urchins, and also in being without the nullipore crust. It is generally characterized by a series of shallow basins, lying one below the other along the slope, the rim of each being

protected by barnacles or worm-tubes. These basins are sometimes several feet in diameter and a foot or more deep, and are often very irregular. Prof. Hartt has compared them in appearance to the basins formed by the hot springs of the Yellowstone valley; but while the latter have been formed by deposition, the former result from wear.

Having now finished our rather detailed study of the reef where it is most perfect, we must proceed farther south and see how it terminates. Nearly opposite the mouth of the river described in the first part of this paper, we find a small channel running underneath the sandstone of the reef, and through this there is a constant movement of water. At the sides large blocks have been dislodged, and, tumbling down, have reduced the width of the upper surface to about thirty or thirty-five feet. It thus becomes evident, as has been otherwise proven, that the sandstone reef rests on a very insecure foundation of soft material, which the water has washed out in places, forming covered passage-ways through which there is a strong current, varying in direction according to the time of the tide. Engineers, in boring through the rock, came to loose sand underneath, demonstrating that the structure we are dealing with is only the consolidated capping of a long bar of sand.

To the south of the channel just described, the reef has been much excavated, not only by the waves but by quarrying; this unwarranted destruction of the only object that gives to Pernambuco its prominence as a commercial city has, however, been stopped, and a breakwater has been constructed at this point, but it is now much out of repair. Around the Ilha dos Pinhos the reef curves slightly outwards, and then, bending westward, approaches gradually to the shore, which it skirts for some distance as a narrow line of rocks, almost lying upon the beach. Another small reef begins to the south, and running obliquely, finally joins the beach.

This closes our imperfect description of the reef as it appears at low water; at high tide, on account of the shallow water without, it is played upon by a very heavy surf, which sometimes rolls completely over it, and wave after wave, rising above the outer edge, bursts high into air on striking the artificial wall at the north. During spring tides the water is much agitated within the reef, but not enough to endanger the shipping.

As a result of his careful study of the Pernambuco reef, and of many others of similar character, some of which we will mention farther on, Prof. Hartt has given us the following conclusions regarding the mode of formation of this class of structures:

It is very evident that they are not the out-cropping edges of beds of sandstone, extending out from the shore, as some have supposed, but only narrow strips of stone of slight thickness, formed in exactly the same position in which we see them to-day, that is, just below the level of high tide. They have resulted from the solidification of beach materials, or sea beaches, by carbonate of lime carried into them by the percolating waters. This action goes on from the level of mean high tide to a variable, but only slight, distance below low tide mark, and has only a limited horizontal extension. By the after encroachment of the sea, aided by rivers flowing behind them, these consolidated beaches have often been separated from the main shore as distinct reefs; but sometimes this latter action has not taken place, and the hardened layer retains its normal position upon the beach.

The agencies concerned in the formation of these hardened beach deposits are mostly very simple ones, many of which can be witnessed by any person visiting the sea-shore. The slope of a sand-beach varies according to the size and character of the sand-grains composing it, the exposure of the coast and the height of the tides. When a wave strikes upon a beach it rushes up the slope in a sheet of foam, carrying with it a quantity of sand. As it returns the sand is spread out over the surface in a thin layer. In this manner a regular lamination, dipping at a more or less even angle, is produced in the material composing the beach. But this regularity is often much disturbed by storms, when the beach may be broken into by the waves and much of its material redeposited at quite different angles.

If the land back of the shore be very low, the beach may form a simple narrow ridge, over which the waves completely break at high water, carrying and depositing sand on the inner side of the beach, where the dip of the laminæ will of course be landward. Ordinarily, however, a ridge of sand is formed behind the sea-beach, above the reach of the tides, being partly due to the action of the surf during storms, but mostly to the winds. Such a beach-ridge as this accompanies most of the Brazilian beaches, which latter, on account of the exposed character of the coast, are formed of quite clean sand, consisting mainly of rounded

siliceous grains, with broken or perfect shells and finer calcareous particles, derived from shells, corals, stony sea-weeds, etc.

The action of the tides is not limited to the surface of the beach, but this, from its porous character, absorbs a certain amount of the water. At low tide the beach just below high tide level is wet but not soaked with water; going downwards, however, we find the beach becoming gradually wetter and wetter until it is completely saturated, producing little rills which run down the surface. With the rise of the tide the level of complete saturation also rises, and when the tide is high the upper part of the beach, for some distance above high tide mark, is completely charged with water, thrown upon it by the waves. A constant movement of water is thus produced in the interior of a beach, but on account of the friction against the grains of sand, this movement can only extend over a comparatively slight width, at least in the upper portions of the beach, which are under the water for only a few hours each day.

Now sea-water, in many parts of the world, and especially within the tropics, is very highly impregnated with bi-carbonate of lime, and this solution, from evaporation or other causes may deposit its lime in the form of a carbonate, which acts as a cement. Where evaporation goes on over a beach wet with sea-water of this character, the surface materials may become consolidated, as occurs at the Abrolhos islands, on the coast of Brazil, and elsewhere. Not only, however, may the upper sands be soldered together, but the hardening may even go on below the level of the sea.

On the Brazilian coast, the surfaces of the beaches are seldom hardened during the ebbing of the tide; but under the hot tropical sun and strong prevailing winds, there must be, in the upper part of the beaches, a concentration of the calcareous solution, which, on sinking downwards to the level of complete saturation, tends to deposit its carbonate of lime as a cement, uniting the grains of sand. The water from rains, percolating through the beaches, may also bring lime, arising from the dissolving of shells and corals in the upper layers, and lagoons, which frequently lie back of the beach ridge, may contribute to the same result. It is evident, however, that the work is mostly done by the sea-water, and that this agent, under certain conditions, has the power of solidifying sea-beaches to a variable distance inland, and to a depth varying from about high tide level to a few feet below low tide level.

If a beach be growing rapidly, or if it is being rapidly worn away, solidification cannot take place, because it is only over a stationary shore, that is neither receiving new accumulations of sand nor parting with its old, that enough time is granted for the accomplishment of this result. Therefore, consolidated beaches must be the exception and not the rule on the Brazilian coast, where the shore is undergoing much change nearly everywhere, and as sandstone reefs seem to be confined to that single country, it must be that there alone are the proper conditions attained for their formation. The hardening appears to extend from the outer side of the beach inwards, and from below upwards, as new reefs usually lie on the lower and outer part of the beach; the younger reefs are also softer in texture than the older, more-finished ones.

It is probable that many of the ordinary Brazilian beaches are solidified below the surface, but until something happens to uncover them, it is impossible to determine the fact. Reefs in process of formation are to be seen on the coasts of both Pernambuco and Bahia, and at Porto Seguro; in the latter province, there is a double reef, the outer one being the wreck of an unfinished structure, the inner still undergoing solidification.

Prof. Hartt was led to believe, from his earlier studies of the Brazilian stone reefs, that a slight elevation of the land was necessary to account for their present position; but his later studies proved to him that such an hypothesis was wholly uncalled for, and that none of the reefs reach above high tide level, or at the most above the level to which a beach is saturated with water at high tide.

Statements have been published that a certain amount of upheaval must have occurred to produce the supposed strong seaward dip of the laminæ of the sandstone; but nowhere, excepting on edges where blocks have been undermined and tilted up, is the inclination greater than might obtain on a sand-beach. To suppose an upheaval to have effected these narrow lines of reef, tilting the strata evenly in one direction, and no part of the neighboring coast, is a geological absurdity. The reefs follow the general trend of the shore, and are more or less curved, but generally straighter than the beaches immediately back of them.

Having shown that the curious reef at Pernambuco, which for many years was a complete puzzle to explorers, has been formed through the agency of very simple forces, in part working upon

every sand-beach in the world, we will hastily glance at the other evidences of the same phenomena on the Brazilian coast.

The northern-most consolidated beach examined by the Geological Commission, is near the mouth of the Rio Parahyba do Norte, where, to the south of a fringing coral reef, there are traces of a short and imperfect stone reef lying upon the shore. Stone reefs have, however, been recorded from north of this point by other observers, but they have never been described; one is situted at the mouth of a small river, about eighteen miles north of the Parahyba do Norte, and another lies in front of the Rio Potengy, in the province of Rio Grande do Norte.

Directly to the south of Cape Sto. Agostinho, in Pernambuco, is the most perfect stone reef discovered; it is almost absolutely straight, its northern end being separated from the cape by only a narrow break or bar, encumbered by loose blocks of reef rock. The land back of the reef, being very low, has been swept deeply away, forming a broad and very shallow bay. The inner edge of the reef is honeycombed and as irregular as that of a coral reef, while the shallow basins of the median and inner portions of the surface are much developed, forming regularly terraced plateaux.

At Rio Formoso, in the same province, there is another stone reef, reaching only about three feet above mean low tide, and not having a great length. The joints dividing the reef-rock are often filled in with sand, which has sometimes been solidified. On the island of Santo Aleixo, not far distant from Rio Formoso, is a small reef of soft texture, lying alongside the beach, and other imperfect reefs also occur in this vicinity on the main shore.

Nowhere near the city of Bahia do we find perfect sandstone reefs; but at the mouth of the bay of Bahia, close to the lighthouse on the outer shore, and on some of the inner shores of the bay, layers of consolidated material occur, capping the beaches and at times covering quite extended areas. They are often composed of very coarse materials and contain many shells, and illustrate beautifully, in many cases, the irregularities of beach bedding.

On the western side of the same bay, at Porto Santo, there is a curious example of consolidated beach structure, the only instance of the elevation of such material of which we are aware. At this place we find a cliff back of the beach, having a length of about 1,100 feet, and a greatest height of about thirteen feet, and composed almost entirely of sand and gravel, cemented by lime into a sandstone. The lower part of the cliff is very hard

in texture, and contains numerous fragments of corals and shells, the latter being frequently found entire. Many of the species of both exist in abundance throughout the bay. The upper part of the cliff is of almost pure sand, and has been so incompletely hardened as to crumble readily between the fingers. The amount of calcareous material in the lower portion is very great, and it is said to yield a good quality of lime on burning.

Whether this cliff belongs to the same class of structures as the reefs or not, it is, at least, composed of the same materials, and must have been formed in about the same way. Its present elevated position—for high water reaches only slightly above its base—indicates that the shore has been raised at this point to a height nearly equaling that of the cliff. What gives an increased interest to this locality is the presence of a low kitchen-midden, only two or three feet thick, which overlies the entire cliff. It is composed of a dark-colored, sandy earth, packed full of the shells of the edible mollusks of the bay, with a few scattered bones, and occasionally a human skeleton.

The stone reefs of the southern part of the province of Bahia, have been very fully described by Prof. Hartt, in the "Geology and Physical Geography of Brazil." The principal ones are those of Porto Seguro and Santa Cruz, both being similarly situated and of about the same character. The former is the larger, and, beginning in front of a small bay formed at the mouth of a river, runs southward, skirting the shore for a long distance. In general structure it is like the Pernambuco reef; the outer edge has become very jagged, from the undermining and falling down of blocks. But below the level of low water, the reef-rock extends seaward a hundred feet or more, forming a very shallow tract, over which one may wade when the tide is out. The inner edge is much thinner than the outer, being often overhanging, and it is flanked by a sloping bank of mud. The surface is of very uniform height, but quite rough, and interrupted by cracks and pools, which teem with marine life. From fractures at the end, it is apparent that the hardening has taken place to a depth of several feet below low tide.

At Gaurapary and Barra Secca, in Espirito Santo, and in their vicinity, are several imperfect reef formations, similar to many already described; and at the Abrolhos islands, as before stated, the sand and shingle beaches are often firmly consolidated by a lime cement.

ROB: A BIRD BIOGRAPHY.

BY REV. SAMUEL LOCKWOOD, PH.D.

IN the clearer light of these latter days, a higher value has settled on the so-called small things of nature. To-day the student thinks he finds in the lower realms of animate beings a psychology, perhaps also a morality, and a self consciousness, which he asserts are the "baby figures" of better things that were ordained to come. It may be that Mrs. Partington spoke wiser than she knew when she said; "Human nature is human nature, if you do find it in a cow." And though so lowly, how educable are these emotional and sensitive creatures! Could one know all about them, perhaps each would be found to have an interesting biography. Let us attempt to tell the story of a tame robin, *Turdus migratorious*.

Rob, for so we shall call him, was taken from a nest on Long Island. Though passed the callow stage, he was not fairly fledged. His pap was meal mixed with fresh milk, a point which he insisted on ever after. He was turned a year old when he became one of our pets, and very soon he had established himself in our affections. He was very exacting of attention—so demonstrative and familiar. In the very pertness of its humor the conduct of the bird seemed paradoxical; for though in its way almost beseeching your notice, it would, on your approach, assume a repellant attitude, with wings striking and bill snapping. But to witness the "high-jinks" of his fury, it was only necessary to intrude a hand into the cage, keeping the back upwards, and Rob would seem wild with savage gladness, for he would settle on it and peck away with his sharp bill at the knuckles as if he were picking into a big bonanza. Much sentiment is wasted about keeping birds in confinement. Does it not generally come from such as are intolerant of pets? "It is a deprivation of natural freedom." So thought the horse in the meadow, as he beheld the ass roaming in the unfenced sand lots. Even birds may have "hard times." Yes, I have known the free wild birds to be starved to death within the sound of a canary's song. But perhaps Rob was unsentimental, for it was plain that prison or not he liked his cage. In it he was at home, and well to do—away from it he was a-drift and unsettled. The door of the cage was sometimes left open for a little while, a proceeding which usually called

for large consideration on the part of the occupant. At such times he would look as quizzical as a knowing young barrister: "Want to get me out, hey? Ah, but possession is nine-tenths of the law!" Still, even wise folks may be inquisitive, and Rob was not above that weakness. He would stand on the door-sill of the cage and with those pretty hazel eyes take in the outlook. This done, with a gravity fitting the act he would step in again, and resume his uppermost seat—the top perch. Sometimes Rob would come out for a little while.

As a rule, excess of freedom is pretty sure to cause our pets to come to grief. The real giant grim of the birdies is Grimalkin; and he is everywhere. We had got lengthening Rob's parole with bad effect on his circumspection. In fact there was a slacking up of the usual bird prudence. One day found him missing. So Rob had run his parole! No, he had not. The pear tree was white with bloom, and he thought to enjoy himself in its branches. Alas, Grimalkin was hidden there, and the catastrophe was serious. We found the poor bird half dead, with a gory laceration of the breast. How he got himself out of the mouth of the carnivore seemed a mystery. But Rob had gone through life so far on his cheek, and my belief is that his escape was due to his plucky impudence. In his case the proverb had been emphatically true: "Familiarity breeds contempt." I had often taken him pettingly into my hands, when, not from terror but sheer temper, he would bite and scream like a vixen. He seemed to fear nothing. As for the cat and the dog they were nobodies whom he saw every day. Now, I have seen the wild robin when caught by the cat, and the victim was as resistless as a clod, in sooth, it was paralyzed with terror. With Rob the case, I think, stood thus: The cat had a hold on his breast with her mouth, but owing to the smallness of the branch which supported her, she had to use all her feet to keep her position although needing the fore ones to help retain her prey, for Rob, though badly frightened, kept his senses, and doubtless used his wings and bill to good purpose on the face and eyes of his grim captor, thus accomplishing his release. It was a long while before the bird got over that wound, which left an ugly though not dishonorable scar.

The bird had its own amusements. Is there not an instinct in whose manifestations our little girls are strangely like the birds?

In their plays how our children anticipate the cares and ways of motherhood—the nursing and the dressing of the doll, the make-believe keeping house, etc. A hundred times have I seen cage birds go through a "dumb show" of mimic nesting, fussing with laborious concern over a feather, or stick, or straw, or hair. I have seen Rob running about his cage with a bit of straw in his mouth, and uttering a conceity twitter, as if he were in live earnest, and saying to a supposable partner in the business: "Here, Mrs. Rob, is just the thing you want."

If one wanted to get Rob on a string, it was enough to give him, in technical parlance, the proximal end of a bit of grocer's cord, reserving to one's self a hold on the distal end. How perseveringly the bird would draw the cord into the cage, and with system too. Seizing it with its bill an inch or two would be drawn in, and a foot put on it, then a little more pulled in and held in place in like manner, and so on until the other end was reached. Now the fun began. Gently the coil was drawn from under the bird's foot; this would bother Rob, for though he was pretty fair on practical reasoning, he could not take a step in the abstract. With quickened energy he would go the thing all over again; and again he would find his labor slipping from under his feet. This at last would excite a spurt of temper, and the thing would be given up in disgust.

Owners of cage pets do not always reflect that birds of the Passerine group are the most delicately organized; hence they are often irritable. Coues has well called them fast livers, they so freely consume oxygen. Rob had a high temper. A trick, perhaps unwise but really amusing, was sometimes played on the bird. A bit of rubber or elastic cord was tied to one of the wires of the cage. Rob would seize it in his bill and pull, though but an inch long, the bird's efforts would stretch it to a number of inches, when just as he was pulling the hardest, it would fly back again, and Rob, to his dismay, would be set back too, with a recoil that fairly lifted him off his legs, and over his tail backward. In the matter of experience the bird never learned at the first lesson, but would keep on meeting the same mishaps, until badly beaten with his own petard, he would give it up as a bad job.

There may not be much dignity in it, but the boy does find some enjoyment in running backwards and forwards by a picket

fence, teasing the testy dog which keeps up with him on the other side. Often Rob had his disposition tried by some one rasping a finger along the wires of the cage. He would pursue the obnoxious digit, snapping his bill furiously, as only a bird can do. By and by would be heard a sharp involuntary "Oh!" telling that Rob had got in a good point on his tormentor, and thus closed the game.

Our robin often afforded matter for study and delight in those expressive attitudes of which birds only are capable, and which too effectually elude the artist's pencil. What high-wrought excitability and poetic expression appear in these movements. What barbaric defiance in the cresting of the crown feathers of the head, that queer furring up, or puffiness of the cheeks, indicating that the hearing is keyed to a strain; that jaunty setting of the head, and saucy cocking of the eye, for a bird never looks so knowing as when he looks sidewise—all this fills a hiatus where speech cannot get in. Even the tail adds to the action. Now comes a decisive chirp. A conclusion has been reached in the bird mind. Next is a series of rapid chirps, making a whirr of sound. This is the call-note of his tribe, for he has detected a turdite in yonder grove, and hark! the call is answered.

But what does Rob know of his clan? Well, some knowledge he has of inheritance, for there is both with birds and men a knowledge which cometh not with observation; some of their ways have come to him by descent. It is now March, and Rob has the spring fever badly, that migratory phrenzy which has set the whole tribe moving north. While the spell lasts he is impatient of home, and is as mad as a March hare. Some robins in that cherry tree have set him fairly wild; and even when there is neither sight nor sound of bird, that migratory impulse, that mystic call to move and mate, keeps the poor bird uneasy. Happily it does not last many days. By April he does something better than chirp, for he gets into a strain like the conjugal song of the robins. Through several days it is so low, soft and silvery, so tender and sweet; but this over the melody is set on a higher key, and becomes a volume of exultant rapture. He has now taken up an octave flute. In his dumpy moods he has been talked to pettingly so much, that he knows the words like a book: "Wake up, pretty boy! Wake up! Wake up!" The boys sing the words, again, and again. Then they whistle them. The bird

catches this little snatch of melody, and executes it in a clear distinct enunciation. This is Rob's best role. Pity that sweetness should ever cloy, but Rob did give us too much of a good thing. Through the summer months, an hour before daylight, on the highest key possible, came that piccolo strain, "Wake up, pretty boy! Wake up! Wake up!" Bob's cage was inside the window-blinds, and by the time the twilight was breaking up, generally several robins had visited the cherry tree near the house, attracted by the singer whom they could not see.

The prince of the mimics is the mocking-bird. But to some degree are not all the thrushes mimics. The cat-bird is really clever in this direction. However I own to a surprise on hearing that Rob had gone into the mimic art. Whenever our black-and-tan, Dick, heard his young master whistle an invitation to take a walk with him, the affectionate brute would almost lose his head in yelping gladness. It was a beautiful day in June, and Dick was seen acting as if half dazed, running up and down the yard looking for his master but unable to find him. Rob had learned the dog-call, and from behind the window-blinds was practicing his new accomplishment. The dog soon saw the trick and slunk away not a little abashed. We all felt that though funny, it was really mean of Rob. Our neighbor's fine hunter was bothered in the same way. Rob tried his hand on the call used by Madame to her poultry at feeding-time. The attempt did him no credit, perhaps for the reason alleged by one of my sons, that "the chickens didn't know enough to get sold." But with some folks failures are simply the preludes to success. Our mimic had grander things in reserve.

Rob's successful play upon Dick was not his only attempt at imposition. On one occasion the good lady of the house being up stairs came running down in great concern, there was such a cry of distress among the young chickens, "Peep! peep! peep!" in rapid plaint smote her gentle ear. To reach them she had to pass Rob's cage. Here she stopped short, and gave vent to an outburst of laughing indignation, for it was Rob, the rascally mocker, who was doing his best to set all the maternal hens at ears about their babies. Though somewhat perplexed, these elderly birds were not very badly taken in. At another effort Rob achieved a marked success; he imitated the cry of the mother-hen when the hawk is overhead—that low whirring note

of danger. All was consternation in the barn-yard. Away sped each callow brood to their own particular mamma, who, though unable to see any danger in the air, yet supposing the alarm to come from some watchful mother that did, instantly took her own charge under her wings. Rob's mimicries were generally perfect. In executing some of them he was so loud-voiced as to be heard a long way off. Persons at quite a distance have been attracted by these notes, and have called to see our "mocking-bird," and been much surprised to learn that it was "only a robin."

The senses of birds must be very acute. I would instance in Rob's case that of scent. He was extravagantly fond of fresh beef, and though in a different room, could tell the arrival of the butcher's boy in the kitchen, when he would scream with impatience. Little strips of raw beef were fed him. If when receiving one morsel he saw another in the fingers of his mistress, he would drop it on the floor of his cage and wait for the next bit with nervous impatience; and so would he do until he had secured all that his sharp eyes saw, which done, he ate these delicacies in a perfectly orderly way. How unlike a dog which swallows as fast as he can the meat given it. But Rob was particular, the meat so providently put on the floor of his cage was thus rendered dirty; the knowing bird would take it piece by piece and wash it in his water tub. This conduct showed the nearest approach to abstract reasoning that I ever saw the bird make. Many of the birds like this condiment of leisure with their food. How often have I seen a fowl pick up a grain of corn, then drop it and look at it, then pick it up, drop and inspect again several times, then swallow it, and all with no other logic in the matter that I could see, than to make the most of one's blessings. So with Rob, having got his store before him, he enjoyed it in a leisurely and sensible way. He was very fond of the larvæ which we used to find in chestnuts. Even these he could smell afar off, and would go into ecstacies, making a lively chattering talk, as one was brought to his cage. The presentation of a spider was a grand event. But as to earth-worms, he had a soul above all such. So far as Rob was concerned, the early bird was entirely welcome to them.

I think our pet must have been five years old when he had a hard time molting, and the result, too, was quite notable. When the large feathers began to come, two white ones appeared in the

tail. Oh, tell it not among his kith that Rob, the plucky and the impudent, shews the white feather! But leaving figure and coming to fact, the truth is, the poor bird was greatly distressed about it, so much so that he made up his mind he would not stand it, but would extract the offensive things, and at it he went. The tail was deflected so as to meet the head, itself turned under the perch; the bill then seized one of the craven feathers and pulled desperately. As if the perch were a trapeze, the bird swung fairly round, going over backwards and falling on the floor of the cage. But the feather had not come out. At it again he went in the same way, and with the same result. And this was kept up nearly an hour, by which time the tail had become all dyed with blood. At last the odious feathers were removed, and the poor bird, weak, bleeding and suffering, put its head under a wing and took rest. What shall be said to this? Was it pride, a certain proper self-respect? We cannot say. But this matter caused us a good deal of solicitude, for it was kept up some weeks, as the feathers would come in white. So at length the bird submitted in sheer despair. When the feathers came to the full there were two white ones in the tail, and as many in each wing. At the next molt the number of white feathers increased. When he was eight years old all the primaries of both wings were of a snowy whiteness, also the retrices, or large tail feathers, except the central pair which kept their normal dark color in bold contrast as lying on a bed of white. This certainly was a strange costume for a robin; in good sooth, his own mother would never have known him. In our eyes Rob, though in an eccentric costume, seemed a gay and elegant fellow.

This partial albinism, we believe, is occasionally found among the robins. But what is its meaning? Attacking the largest feathers of the tail and wings, it might indicate inability of the pigment cells to furnish color any longer at those parts of the plumage where the demand was the greatest. It is doubtless due to an exceptional atrophy of the secreting color-glands.

Our pets were usually divided round in the family. Rob was claimed by my daughter. It was a tender parting when with her husband she left for a new home in a great western city. And even Rob had no small share of our good-byes when taken to the car with the bridal pair. In his western home he was allowed enlarged freedom, his cage with open door being often set in the

garden. When his cage was hung under a tree by the side-walk, the pedestrians would stop and wonder what bird that could be with so strange a plumage and so novel a song. When free in the garden Rob would have a good time of it, occasionally finding a dainty insect. But the dear fellow was getting old. Nine years is rather high for *Turdus migratorious*, and his appetite was becoming a little unnatural. He found a piece of twine, and by persevering succeeded in swallowing it. That was the worst string ever Rob got on. That western investment was the death of him.

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ON THE MORPHOLOGY OF THE SEMICIRCULAR CANALS.[1]

BY FRANCIS DERCUM, M.D., PH.D.

IN biology we meet, at every step, new and interesting questions. How this or that structure arose, what this or that fact means, are the problems which continually present themselves. The data are few and scattered, yet the attempt to arrange them in some logical manner is at least justifiable, and though our success may be doubtful, we at least take a step in the right direction.

Such an attempt let us make in regard to the semicircular canals. Under the idea that these structures, like all others, were formed for a special purpose—were designedly made to meet certain ends—a great variety of functions have been assigned to them. Viewed in the light, however, that every organ is the resultant of certain definite and interacting forces, the mere question of actual or present use becomes a secondary one. Let us see what the various facts I have collected seem to point out.

Before we attempt to understand such a complex organ as the ear, it would be well to look over the field of zoölogy to see whether we cannot find other and simpler organs of sense, which may perhaps give us the right clue. Such organs I believe to be the so-called mucous canals or lateral lines of fishes and amphibians. These structures, I need hardly say, have been ably demonstrated by Leydig, F. E. Schulze and others to be sensory. They consist essentially of small areas of nerve-epithelium arranged in linear series along the sides of the head and body, having hair-cells continuous with nerves and being in every way comparable

[1] Read before the Alumni Association of the Auxiliary Department of the University of Pennsylvania, March 28, 1879.

to the maculæ acusticæ of the ampullæ and vestibule. They have received as yet no specific name. Leydig simply uses the expression "nerve-buttons" (nervenknopf), and F. E. Schulze "nerve-hills" (nervenhuegel). In the adult forms of almost all fishes, these structures are inclosed in a continuous canal formed in the epithelium. To this fact we will return again.

The function of these organs appears to be to appreciate mass movements of the water, and more particularly vibrations which have longer periods than those appreciated by the ear.[1]

Besides the similarity in the structure of the maculæ of the lateral lines and the maculæ acusticæ, the following facts indicate a close relation between the two sets of organs. In the first place, in accordance with the general law of the development of sensory structures,[2] both the ear and the mucous canals are developed from the epithelial layer of the embryo, namely, the epiblast. Secondly, the side organs of the head are supplied by the fifth pair of nerves, while those on the body are supplied by the lateral nerves, which in turn are made up to a greater or less extent of the fifth. Now, a fact, the significance of which can never be over-estimated, is, that in the skate the auditory nerve is a primary branch of the fifth.[3]

Again, the organ of hearing is surrounded by bone really belonging to the ectoskeleton, but usually becoming incorporated with the bones of the cranium. In the same manner the side organs of the head are surrounded by bones belonging to the ectoskeleton, and likewise becoming more or less incorporated with bones of the skull and face. The supratemporals, suborbitals and lachrymals are examples of these. Even in the side organs of the body the same tendency to the persistence of bone is manifested by the occasional presence of bone corpuscles and even of cartilaginous or osseous grooves or canals. Now, while I recognize in this comparison only a very general fact, I still think that the parallelism between the bony support of the ear and the bony supports of the side organs is far greater than between the petrosal and the sclerotal.

Let us now turn to the development of the mucous canals,

[1] See Archiv f. Mikroskop. Anat., VI. F. E. Schulze, Ueber die Sinnesorgane der Seitenlinie bei Fischen u. Amphibien.

[2] See Am. Naturalist, Sep. No., 1878. The Sensory Organs, by the writer. Also Cosmos, 1878, Oct. and Nov.. Die Enstehung des Sinneswerkzeugs, by Professor Haeckel.

[3] Owen, Comp. Anat. of Vertebrates.

and see how much of general application can be gleaned from the facts. In teleost fishes the side organs first exist as mere cellular elevations[1] projecting into the water and having the percipient structures, the hairs, protected (generally, not always) by means of a delicate hyaline cylinder open at its distal end. In most cases this stage is transitory. Above and below the elevations, the epithelium of the surrounding skin becomes raised, forming a groove which is finally converted into a canal. Thus these elevations or maculæ of the side organs become enclosed by a process somewhat analogous to the involution of the ear.

In Elasmobranch fishes, however, another method is pursued. The lateral line appears already in the embryo as a fully formed canal, and, instead of being produced by an inflexion of the epiblast, is formed directly by being hollowed out in the substance of the same.[2] This departure from the general method of the development of sensory structures is an illustration of an important fact dwelt on by Herbert Spencer, namely, that the processes pursued in the development of the embryo are by no means the exact repetition of those which occurred in the evolution of the race. In many respects the processes of embryology are shortened. The integral parts or molecules of many structures tend to assume directly the relations which they occupy in the adult form, without passing through those intermediate stages which were successively traversed by the ancestors of the races.

This marked difference between the development of the lateral lines of Elasmobranchs and Teleosts is in harmony with several other interesting facts. We would naturally suppose that an organism in which a comparatively complex structure is produced by the direct method, is relatively both older and higher than one in which the same organ is produced by the indirect method. In the present instance this is the case. The Elasmobranchs constitute an order of fishes of vast antiquity, making their appearance already in the Upper Silurian, and being, therefore, among the oldest fishes known. Again, they constitute a very high order being perhaps, with the exception of the Dipnoi, the highest. They are even related in some respects to amphibians. The Teleosts, on the other hand, are ordinarily regarded as the representatives of the piscine type ; that is, as presenting preëminently those characters which constitute a fish. Secondly, the Teleosts

[1] The nervehills of F. E. Schulze.

[2] See Balfour's Monograph of the Development of Elasmobranch Fishes, 1877.

are an order which is comparatively very young, not making its appearance until the Cretaceous period. Observe how these facts accord with the development of the lateral line. In Teleosts the involution of the maculæ or nervehills of the lateral system and the consequent formation of a canal, does not take place for days and even weeks after the young fish has left the egg. In one instance, *Gobius minutus*,[1] it does not take place at all. In Elasmobranchs, however, as stated, the canal is already formed in the embryo.

Surely such a harmony of facts must be of significance, and they must open our eyes very widely with regard to the relation between embryological and race development, or, to use the words of Prof. Haeckel, between ontogeny and phylogeny. Doubtless in the primitive Elasmobranchs, or in their ancestors, the development of the mucous canals was similar to that of the Teleosts of the present day, but, in the countless repetitions during countless ages, the process was shortened and made, as we find it, immediate and direct.

Now, what bearing have such facts as these on the correct understanding of the embryology of the ear? Let us see.

Can we suppose that a structure as old as must be the organ of hearing, is still formed in the embryo by repeating the various stages once traversed by our remote ancestors? Would it not be more philosophical to expect that this organ is now produced by a process more or less direct? To this latter view I think we must, by necessity, incline.

The embryology of the ear may be briefly stated, as follows: It first makes its appearance as a depression of the epiblast in the neighborhood of the hind-brain. This depression gradually deepens until, by the coalescence of its edges, it is converted into a closed cavity. This cavity then rapidly enlarges and certain dilations or protrusions of its surface into the surrounding mesoblast take place. These protrusions are severally converted into the semicircular canals and cochlea. In the case of the semicircular canals each dilatation becomes flattened, and, by the meeting and coalescence of its opposite walls in the middle, its peripheral portion is converted into a tube, both ends of which remain permanently in communication with the primitive vesicle. The cochlear protrusion undergoes no such transformation but is simply prolonged, forming the true membranous cochlea or scala

[1] See F. E. Schulze, loc. cit.

media of mammals; but with this we have at present nothing to do.

Evidently the first stage of the development of the ear, the process of inflexion, belongs to the indirect method, but the fact that this process is still so pronounced, and the fact that the otic vesicle when once shut off from the epiblast rapidly enlarges, so that the area of the enclosed surface is relatively very great, would indicate to my mind that in our remote ancestors, this process of inflexion was very marked—that it was extensive, involving a a comparatively large area, and bringing about great modifications of structure. The tendency in the constant repetition of this process would be to diminish its relative importance, *i. e.*, to make it constantly less and less pronounced. Probably, therefore, the amount of surface actually inflected in the embryo is small compared with the area inflected in the process of ancestral development. To this we will presently return.

The special parts of the labyrinth appear to be formed by a direct method. This would, of course, as we have seen reason to believe, not exclude the possibility of an indirect method having obtained in our remote progenitors.

Having now compared the various methods pursued in the development of the mucous canals and the ear, let us recall a fact which has not yet been brought into sufficient prominence, namely, that the structure of the mucous canals and that of the semicircular canals is very similar. In 1850 Leydig[1] already noticed this fact, for he compares a semicircular canal and its ampulla with a mucous canal and its "nervebutton." Both structures consist of connective tissue lined with epithelium, and the "nervebutton" of one corresponds to the macula acustica of the other. The analogy seems complete.

Would it now be too hazardous to suggest that two organs which are so closely related in structure, which present such significant facts, as regards nerve supply and embryological development, are related genetically? Such a supposition would evidently not be inconsistent. Let us see how it may have been brought about. In an organism provided with a general apparatus for the perception of vibrations, evidently the first thing that would take place would be a specialization of certain portions for certain classes of vibrations. This is what may have been the case with the lateral canals and the ear, each being a specializa-

[1] Mueller's Archiv.—Schleimkan. d. Knochenfische.

tion in its own peculiar direction.[1] The fact that the involution of the side organs in Teleosts does not take place until the organism is already far advanced towards the completion of its development, and the fact that the mucous canal in the embryo of Elasmobranchs does not appear until the epiblast has been differentiated into its two layers, both imply that the side organs had for ages existed as mere "nerve-hills," or nerve epithelium, projecting into the water, and this renders our idea not only possible but probable. In the course of the evolution of the ear the first differentiation of structure that occurred may have been as follows: Certain of these areas of nerve-epithelium or sensory maculæ, may, for functional specialization, have become enclosed in canals. (The great functional advantage of this form of involution over the closed vesicle, we shall presently see.) Now, for still greater specialization, the whole area containing the canals with perhaps one or two maculæ not yet enclosed, may have undergone a general process of involution and thus given rise to the vestibule and semicircular canals.

This view of the evolution of the ear is favored by the fact that the semicircular canals are *constant structures in all vertebrates!* Again, their number is always the same, namely, three, with but two exceptions, which may be easily explained. I refer to the Myxines which have but one, and the lampreys which have but two. Probably no naturalist who accepts the theory of evolution, looks upon the selachians or any other existing order of fishes as ancestrally related to the other vertebrates, and even the structure of the Marsipobranchs indicates that they belong to an *early differentiated* and highly aberrant type.

In studying the gradual development of the ear, palæontological evidence, unfortunately, cannot come into play. It is too fragmentary. The very first vertebrates that we find are already fishes of a high degree of development.

Let us now see to what views of the functional value of the semicircular canals, the above discussion leads. The first question that arises in our minds is, what is gained by the involution of the sensory maculæ? And secondly, why should this process have resulted in the formation of canals? Why did not each macula become enclosed in a separate cavity? Probably the benefit derived by a delicate sensory structure from the formation

[1] In this category it would be no more than just to include such structures as the *sensory ampullæ* of sharks and rays and the *Savian vesicles*.

of a wall about it, is at first of a protective character, and the final formation of a cavity is the further attainment of the same end. This, however, would entail a greater or less modification of function. The exposed sensory macula would probably perceive vibrations clearly and distinctly. As soon, however, as enclosure in a cavity takes place, interference of the vibrations by their continued reflection from the walls of the cavity must necessarily occur. Such a condition of affairs is probably present in sensory structures like the "mucous" ampullæ of sharks and rays and the Savian vesicles. This difficulty is overcome if, instead of there being a cavity closed on all sides, the macula is situated in a tube. Then interference would either not result at all, or be greatly diminished, for the vibrations would be dispersed in one or two definite directions. The formation of such a structure may have been the first step in the evolution of the ear. Indeed, its parallel is presented to us in the lateral lines. The very same conditions obtain.

The question now arises, when the area containing the structures about to form the ear became involuted, in what way was the function of the tubes converted into the semicircular canals modified? In other words, what is the function of the semicircular canals? The fact that both ends of each canal communicate with the utriculus, probably lessens their use as dispersing vibrations, but at the same time another and very important condition obtains. The utriculus, a comparatively small cavity, has the area of its enclosed surface materially diminished by the presence of five openings, three of which are comparatively large. In this way the capacity of its walls for reflecting vibrations must be considerably lessened, and interference of vibration consequently much diminished. Thus one function of the semicircular canals is probably to assist clearness of perception,[1] and in this respect their function would be intrinsically the same as that of the canals of the side organs. It has at various times been argued that the semicircular canals prevent interference of vibrations by the sound waves entering the same canal at opposite ends, and then meeting in opposite phases, thus mutually destroying each other. How this could occur I cannot imagine; there is no special contrivance at either end of a canal by which the vibrations would be retarded just half of a wave-length, and there is no reason why such an assumption should be made. On the contrary, I cannot see any-

[1] This was the idea of Prof. Jackson, formerly of the University of Pennsylvania.

thing to prevent the waves from meeting in exactly the same phases. If so, the effect of the semicircular canals would be to increase the intensity of sounds.

Various other uses have, at times, been assigned to the semicircular canals, such as the estimation of the direction of sound, or even the appreciation of pitch, besides which, conclusions have been drawn based on vivisection. Theories concerning pitch were held prior to the understanding of the structure of the cochlea, and may be dismissed without discussion. Those concerning the direction of sound are not borne out by fact. In the first place, as the contradictory results of investigators show, the power among animals of distinguishing the direction of sound is not well marked, and even if it were it would be no proof that this power lies in the semicircular canals. Again, it is self-evident that the direction of sound cannot be maintained while passing through the auditory meatus and tympanum, and if we are told that the semicircular canals appreciate vibrations transmitted by the skull, the conditions are singularly unfavorable, for just in those animals in which an appreciation of the direction of sound would seem the most important, *i. e.*, birds and mammals, the head is generally covered by a non-conducting material, feathers or hair.

The power of distinguishing the direction of sound seems to me rather to be connected with the degree of development of the auricle and the degree of its movability, or the power the animal has of quickly adapting the head to various positions, so that it can determine that position in which the impression is received the most strongly, and thence infer the direction of the sound.

The theories based on the vivisection of the semicircular canals, involve a method of reasoning that to me is not logical. To say that the results of a terrible mutilation of one of the most highly specialized parts of the body, namely, the head, are due to the destruction of any one organ or part contained in it, is certainly reasoning from incorrect premises—is certainly leaving out a large class of the facts. Secondly, to predicate that the function of an organ is the inverse of certain phenomena obtaining by its mutilation, is less logical still. To my mind the experiments of Flourens, Goltz and others, do not demonstrate that the results were due *only* to the mutilation of the semicircular canals, or that even if this were the case, anything could be predicated concerning their function. To use an apt illustration, let us take a watch and let us imagine that it was to us a new and strange

machine, the various functions of which we wished to determine. Now, what would we think of a man who would plunge a knife through crystal, dial, mainspring and all, to find out how the thing worked. Is the proceeding in the case of an animal any less absurd? Is it more encouraging to know that the machine with which we are dealing is infinitely more complex, and of the fundamental truths of whose construction we can only gain vague and fragmentary ideas?

In order to understand a complex organ—if, indeed, the attainment of such an end be possible—I believe that we must cast about for the most widely scattered facts, and then view these in the broadest possible light. I believe, therefore, that the only way to understand an organ for the perception of sound vibrations, is also to study organs for the perception of allied vibrations, and then to compare the various principles involved in the development, structure and function of each. By the pursuance of such a method in the present instance, the conclusions which seem to be pointed out, are, first, that the chief significance of the semicircular canals is *morphological*, and secondly, that their functional importance, though considerable, is secondary. If, in the above discussion, I have merely raised this view of their nature to the degree of a probability—which is the most that circumstances allow—my object is accomplished.

Addendum.—After the reading of the above paper, Dr. A. J. Parker offered a suggestion with regard to the function of the semicircular canals which makes the parallelism between these structures even more apparent. His view, which he permitted me to append, is as follows:

He says that the maculæ acusticæ are very probably situated in just those parts of the labyrinth on which the sound waves impinge with the greatest intensity. This being the case with the maculæ of the ampullæ, the sound-waves probably enter the ampullar ends of the canals with much greater force than they enter the non-specialized ends. Consequently, when interference takes place, it occurs in or near these non-specialized ends, *i. e.*, where there are *no acoustic spots!* Dr. Parker looks upon the semicircular canals as so many conduits to carry off vibrations after they have impinged on the maculæ of the ampullæ. This would make their function exactly analogous to that of the lateral canals.

Dr. Parker's view also explains why each semicircular canal has but *one* ampulla, and why this should be situated at the *end*, instead of other parts of the tube.

TEXAS IN ITS GEOGNOSTIC AND AGRICULTURAL ASPECT.

BY J. BOLL.

HAVING resided for several years in Texas, during which time I have constantly been engaged in scientific researches, I shall, in this article, aim not so much at a geological and geognostic description of the country, as attempt to present results already made known by others, and to give a slight view of my own observations in the same field. I shall not undertake a description of rocks and minerals heretofore found in Texas, nor enumerate animals already known as extinct or as still existing; but rather from the nature of the soil and the constitution of the mineral kingdom, draw my conclusions as to the fertility and products of the different parts of the State.

Of the various publications by other persons on the geologic and geognostic conditions of Texas, the following are known to me:

1. Texas, with special reference to German emigration and the physical condition of the country, as described after personal inspection by Dr. Ferdinand Roemer, together with a scientific addendum. Bonn, 1849.
2. The Chalk-formations of Texas, and their organic contents, by Dr. Ferdinand Roemer. Bonn, 1852.
3. Exploration of the Red river, in 1852, by Rand. B. Marcy, in which the northwestern part was geologically described, by Geo. B. Shumard.
4. The Annual Reports of State Geologist Buckley.
5. The Map of Texas, by A. R. Rössler. 1874.

The geographical character of Texas, as Roemer correctly remarks, divides it into three districts, more or less sharply defined. These are:

1. The Lowlands, along the whole coast, from the Sabine to the Rio Grande. They vary in width from thirty to a hundred miles, rising from three to a hundred feet above the sea, and are really only a continuation of the coast-lands of Lousiana, Mississippi and Alabama, and therefore belong to the same diluvial and alluvial formations, being almost wholly composed of clayey and sandy deposits. However, it is not alone the rivers coming from the interior which collect and bring down this material, for the sea also contributes its part. As proof of this, we find in the soil, not only the remains of marine animals, but the animal and vegetable world still extant gives evidence thereof. Here, not

only on the coast but in the whole region, we find those plants and insects living near salt-water only. The long narrow islands lying along the coast of Texas must necessarily, on account of their situation and physical condition, be considered as parts of the Lowlands.

2. The Hill country, or Uplands. This consists of the prevailing level and hilly region between the lower coast-range and the higher and partly rocky highlands beyond. Its width is from a hundred and fifty to three hundred miles, about one hundred to one thousand feet above the sea. According to its geological composition, it partakes in equal parts of the tertiary and secondary formations. The fertility of its soil is exclusively due to the composition of these formations, hence within it are embraced the fairest and most prolific portions of the State. Large, extensive prairies are situated in the west, with strips of timber along the creeks and rivers, also large and small forests diffused here and there, but composed wholly of post-oak. The eastern portion is almost entirely covered with forests of a great diversity of timber.

3. The Highlands. These arise behind the rolling hill-land, beginning in the west on the Rio Grande, where, at its confluence with the San Pedro, it suddenly turns its eastern into a south-eastern course. Thence the boundary extends due east to the great sources of the San Antonio; thence north-east to Austin; and thence due north it reaches the Red river near the mouth of the Little Wichita.

From the Rio Grande to Austin, the boundary between the Hill country and the Highlands is well marked and sharp; while from the latter point to Red river the transition is more gradual and more difficult to define. The highest places in it rise scarcely 2500 feet above the sea, excepting the Guadalupe mountain, west of the Pecos river. In the north-west part of the State, towards New Mexico, the elevation slowly increases towards the Rocky mountains. No higher mountain chains are at all to be seen, and this region has rather the character of a high table-land. The inequalities arise more from the excavations of valleys and ravines, while the elevations generally maintain the same level. In its geological character it is greatly diversified, belonging, as it does, to the tertiary, secondary and primary formations. In very many places the soil is very dry, sterile and rocky, especially the

valleys in the south, presenting steep and rocky entrances, rarely widening into fertile plains. All the principal rivers of Texas rise in this division, which is but sparsely settled and but imperfectly explored and known.

If now we take under review the formation and composition of the soil of these different parts of the State, the following will be the result as to their fertility and products:

In general we distinguish three different kind of soils—sand, clay and limestone—in the first, sand or silica predominates, in the second, clay, in the third, carbonate of lime. Neither of these constituents alone is sufficient to produce a vigorous growth of plants; that this is the case with sand is proved by the great deserts of Asia and Africa. When sand constitutes more than nine-tenths of the soil, vegetation cannot flourish; yet all soils require a certain proportion of sand, because every plant needs some sand for its growth; for cereals especially this element is indispensable. The clay soil has also its defect, it is too tenacious, so that the roots cannot spread out; it retains water too long, and when it dries it hardens into tough lumps; it has, therefore, precisely the opposite faults of sand, wherefore a proper intermixture of the two proves advantageous. A soil consisting solely of lime varies too violently in moisture and dryness; lime is, however, as indispensable for the nutriment of plants as sand, so that mixed in proper proportions with sand and clay, it proves itself highly advantageous in every respect; hence soils composed of sand, clay and lime are, without doubt, the most fertile.

Now, as regards Texas particularly, its sandy soil was mainly derived from the sandstone of the tertiary period, whilst its clay and lime soil deposits came from the tertiary and Mesozoic ages.

The soil of the Lowlands is, through the accumulation of sand, clay and lime, brought into a mixture very beneficial to cultivation, but owing to the presence of salt, and still more to its level surface, which hinders the discharge of water, it is not adapted to every kind of cultivation, wherefore wheat cannot be raised, whilst Indian corn, sugar-cane and cotton succeed admirably. The entire Lowlands are not yet extensively cultivated, and its more general culture depends upon a thorough system of drainage. The condition of the soil is everywhere the same, neither stones nor rocks are to be seen.

In the Hill-country we find the sandstone, and the sand and

clay deposits of the tertiary formation in vast extent, and the peculiarity of it is that these places are, throughout, covered with forests, indeed we may safely conclude that wherever extensive forests are found in elevated positions, they arise from a tertiary foundation. Thus the whole forest-clad parts of Eastern Texas, from Red river down to the sea-coast, consist of these formations, the upper and lower cross timbers of North-western Texas, like the post-oak forests situated in the middle and southern, rest throughout upon tertiary formations. Since now the soil there, mainly through the influence of the glacial era, was derived from sandstone and sandy-clay deposits, it is, therefore, less adapted to the cultivation of plants, having obtained a large share at the same time through a considerable proportion of iron, as we shall see later; yet along creeks and rivers are found here and there places fit for cultivation. In the first years of culture, plants flourish generally quite well; but the strength of the soil is soon exhausted, which has strikingly exhibited itself in parts of Louisiana bordering on Texas, this side of Red river. This region has been for a long time thoroughly cultivated, and at this time has only two-thirds of its former extent under culture. Wheat does not succeed in this soil, and cotton is mostly only one to two feet high; corn is weak in the stalk and the ears are small; fruit-trees alone flourish there, viz: peaches and apples, since these trees are enabled to send their roots deep into the ground. Pines, which grow best in sandy regions, diffuse themselves to a great extent through the forests. Since then, by means of forests, we can decide the tertiary foundation of the soil, so in the same way we may state that open prairies and places covered with mesquite trees, indicate that the soil rests upon secondary formations. There again the soil is formed of sand, clay and lime, through the operation of the glacial era, and mingled together in so advantageous a manner that it presents all those conditions on which depends the perfect development of all cultivated plants. This division embraces that part of Texas which promises to become so large a source of food such as no other State of the Union possesses, even such as can be found in few portions of any continent. Again, in this same division is that region of peculiar importance in which naked rocks appear on the surface, neither to a small nor great extent immediately after the tillable ground has been broken up by other causes.

Such a wholly continuous area, more than one hundred and twenty miles wide, and over two hundred miles long, lies in the northern part of the Hill-country of Texas. It forms a long rectangle, of which Dallas county is nearly the center, and this is the reason why this division, and especially the city of Dallas, have so rapidly grown in importance, and this proves at the same time with what keen foresight railroad magnates have stretched their iron roads through this section.

This division is, however, penetrated in its north-western part by the so-called Cross Timbers, two strips of forests from eight to ten miles wide, the soil of which consists of the tertiary elements, but their intermixture through the physical influences of the glacial period, since the extent was not very great, became much superior to that in Eastern Texas. Besides, it constitutes only a very small part of the division under consideration, and supplies at the same time, to the adjacent prairies, convenient and adequate material for fencing and fuel, which only in few places has to be procured from considerable distances.

In the southern and south-western portion of the Hill-country, as far as the Rio Grande, the soil is also composed of sand, clay and lime, yet, as in the northern part, it is more frequently interrupted by tertiary clay and sand, but much more, and more injuriously to agriculture, is the ground filled with hard, reddish flint stones, from the size of a pigeon-egg to that of the fist. These originate in the Highlands north of it, on one side of the primitive mountains arising there, and still more from the extensive chalk hills. This chalk formation of the Highlands is of a sandy character, hard, and enclosing a great number of sand and flint concretions. After the drift period they remained scattered in every direction, and this readily explains why these concretions are found not only in riverbeds but also on those higher localities surrounding the valleys, and particularly on hills. The soil of this part of the Hill-country is here and there so filled with these stones that it is useless to undertake a thorough culture of it. Although these places often interrupt the fertile soil, yet the latter comprises a considerable area, and it is especially the river-bottoms which in the southern part of the Hill-country possess an immense productive power. In the valley of the San Antonio river, almost the entire bottom of the valley can be irrigated for a great distance, yet this system of irrigation, constructed by the

Spaniards many centuries ago, has already so exhausted the soil of loose, light mineral material, that a rich crop can no longer be reckoned upon excepting here and there.

In this connection the following points may be mentioned. Till now it has always been a problem where the great sources of the San Antonio river, as also of the Comal and San Marcos, have their origin, and why these throughout the whole year continue to break forth from under the rocks with the same force and temperature as well as with unvarying clearness.

Roemer, in his work on the chalk formations of Texas, says, that the chalk of the Highlands is proven by its organic remains to belong to a somewhat deeper geognostic horizon than that of the Hill-country, and is therefore older, although it lies higher. It is suddenly separated, steep and sharp, from the latter. He says, furthermore, it is possible that through a fault not apparent on the surface, the chalk of the Highlands near New Braunfels was forced back to the higher level, and he believes that such transposition and also the sudden and steep upheaval of the Highland, explains the remarkable change in the character of the rocks, and that the abrupt breaking forth of the sources of the Comal at the foot of the table-land has a close connection with it.

Northward and located somewhat higher there appears in a singular manner, almost wholly surrounded by the chalk formation of the Highlands, an entirely isolated tract of primitive mountain formation, and it is well to observe that this piece was lifted up through terrestrial forces after the chalk formations had already detached themselves. On this granite are found here and there isolated remains of chalk. Before the glacial era the entire mass was entirely covered with it, and it was almost completely destroyed during this long period, and I might therein discover not only a proof of its later upheaval, but also of the existence of the glacial era; so also other and not yet solved problems may here find a solution. Through the upheaval, the volcanic force extended also to the chalk surrounding the granite.

As already remarked, the chalk of the Highlands is much harder than that of the Hill-country; as a collective mass it resisted the upheaval, and was therefore lifted up at once with the granite: hence the steep declivity at the foot. By the upheaval considerable cavities would be formed in and under the

chalk, for it is everywhere much cleft, and the rain falling on the ground finds its way slowly, therefore, partly through the rocks, into the cavities. It can accumulate in large quantities in these hollows; the water must necessarily find an outlet again, and thus it is probable that the above-named rivers come from one or more subterranean lakes, and hence their uniform force, temperature and clearness. The water of these springs holds a great deal of carbonate of lime in solution, which shows that in the course of time the cavities are more and more enlarged; this view opposes at the same time the opinion that the water takes its origin in the Staked Plains of North-western Texas; if this were the case they must contain not only the carbonate but also the sulphate of lime in considerable quantities, since gypsum is extensively diffused there.

Passing now to the Highlands, which embrace the whole remaining part of Texas; it is the largest but the least satisfactorily known. The tertiary formation is very little diffused, and hence the soil is mainly derived from primary and secondary deposits. Nowhere are found extensive tillable and continuous tracts as in the Hill-country; the good planting-ground is mostly confined to the river-bottoms and valleys; only in particular counties are larger tracts of tillable land to be obtained. As already remarked, this high table-land is mostly rocky, dry, and sterile; but owing to good meadow-grounds, it is particularly well adapted to cattle-raising, which therefore is followed in a very extensive manner.

These Highlands have, however, for Texas a particular importance in other respects; it is mainly there that mining will, in future, be prosecuted.

As regards the evidences of mineral wealth, we need not, for known reasons, look for them in the surface of the Lowlands. The whole of the Hill-country encourages no hope of rich mineral treasures. Throughout this entire division, however, coal has been discovered in many places; but, according to all scientific principles and personal observations, I must declare that there has been found no coal belonging to the genuine coal-formation; but only such of the tertiary and secondary periods—the so-called lignite or brown coal. It is, also, nowhere found in extensive and vast deposits, rarely easy to work; although that of the secondary division, as approaching nearer in age to genuine stone-coal, possesses in a considerable degree the elements of fuel. In many

parts of the undulating Hill-country are found masses of petrified wood. As Roemer already correctly concluded, this belongs to the tertiary formation; and we can, therefore, by this means decide with certainty upon its presence there. The immense proportion of silex in this formation has petrified the wood, instead of carbonizing it.

On the bank-slopes of the Red river, near Shreveport, I found a layer one to two feet thick, which was half carbonized, and half petrified; and in the same stratum lay large logs of cypress in a half carbonized and half petrified state.

The large deposits of iron-ore in the tertiary formation of Eastern Texas may become of somewhat more importance than the coal in the Hill-country, but they by no means equal in value the ore-deposits of older origin. The iron is here found mainly as iron sandstone, and in many counties, as in Henderson, Anderson, etc., in such quantities that whole ranges of hills are formed of it; and the region presents many times, by their rocks and the ravines between, a quite romantic character; this is particularly the case with the so-called big rocks between Vanzandt and Henderson counties. The tertiary formation is also rich in salt deposits, and in many places the salt is successfully obtained from salt-springs. In the iron regions we encounter in some places very strong mineral springs, especially sulphur-springs. They hold in combination much carburetted hydrogen gas and sulphuret of iron; when they come to the surface, they liberate blackish gray and yellowish precipitates of sulphur and sulphuret of iron; but they do not come from any considerable depth like thermal springs, since they have nearly as low a temperature as the ordinary springs of the neighborhood. On the Neches river, as well as on the Sabine, I found larger deposits of a blackish-iron sandstone, which was quite loose and brittle; it holds iron mostly as sulphuret of iron. Owing to its slight coherency, the latter may, through several influences, be easily decomposed, and then on the one side give cause to the sulphur springs, and on the other to the sulphate of iron produced in that region. There are also many beds of clay, which contain alum, or bittersalt, and impart for this reason a strong taste to water; in particular places, in summer, there is seen in the bottom of tumblers, after the evaporation of the water, a white crust of this salt. Of greater importance to mining in Texas are the Highlands.

From the mouth of the Little Wichita into the Red river down to the Colorado river, where the Pecan bayou empties into the same, there lies, towards the west, a region about one hundred miles wide, that belongs to a much older mountain formation, the so-called coal or transition mountain. In this is found in abundance the copper-schist or the Permian system, as also the Silurian. Shumard looked already upon this region as belonging to the coal-formation; and the organic remains which exist in the rocks speak most plainly; such are trilobites, fossil fishes of the families of Ganoids and sharks, and the imprints of the ferns with Equisetaceous and other plants. I have found also in this formation various Mollusca, chiefly *Brachiopoda* and *Lamellibranchiata*, wholly petrified in the iron-ore, called sphærosiderite. We find now and then, on the surface of this coal-formation, copper-ore, consisting mainly of malachite, which originally penetrated in veins through sandstone; it is often several inches thick. There are also found immense masses of iron-ore in very many different conditions, lying around loose on the slopes, in ravines, and everywhere; and especially those that appear most numerous, are the hematite and ironspar or sphærosiderite; and which, it seems, have been taken by some persons for copper; yet I have no doubt but that considerable copper and other ore deposits may still lie hidden in some deeper stratum. The different iron-ores contain, according to my analysis, twenty to seventy per cent. pure iron, and among them many spars, a little zinc, and traces of cadmium. If we compare these ores with those of other countries, it is apparent that they are among the best, and most easily reduced; they are the same ores out of which nearly nine-tenths of all the iron in England is produced.

From these geological and palæontological facts, we are permitted with all certainty to conclude that, although hitherto no positive data have existed, there must be throughout this whole division large, extensive, and genuine coal-beds. In the geological State museum at Austin can be seen large pieces of genuine stone-coal, but without any precise information as to the place of discovery.

Bismuth and antimony, it is claimed, have already also been found. Some time ago the newspapers gave information that a very rich silver mine had been discovered in Montague county; but it may well be doubted whether this news is correct, and it may

have been published from interested motives. Gold, silver, lead, and molybdenum are, however, found in the previously mentioned primitive mountain formation of the Highlands, where in later times, in Llano county, a silver mine is said to have been put in operation. Westward of the coal-formation, particularly along Red river and in the Staked Plains, lie very large beds of gypsum; but the future must reveal to us how large treasures in metals lie in the still unknown regions of the west.

If we cast a retrospective look over the whole, we may assert with all certainty that Texas is approaching a very promising future. It is a country in which, on account of its fine and favorable position, not only all the plants of the temperate zone flourish, but also many of those of the tropics. The wine-culture, to which many a State owes its prosperity, is yet in the germ; but the results attained on a small scale hitherto, the great number of excellent wild grapes, as also the above-described constitution and combination of the soil,—are all speaking evidences of its adaptation to this noble fruit.

Texas has its own pine-forests in the east, which will be fully adequate to supply the whole State with lumber, and to fence in the fields; in the interior it has its own granary; and when once her own hand has wrought her own iron with her own coal, then will she supply not only her own wants, but many of those of the outer world.

Nowhere are there extensive swamps which makes residence unhealthy; the country has also no sections which suffer from excessive drouth. Winters have neither the northern cold, nor the summers the tropical heat; and pleasant breezes throughout the whole summer keep the air continually, not only in a refreshing condition, but contribute much to the salubrity of the country. Though we may not have to point out lofty, romantic mountains, still there are regions highly favored by nature, particularly those about San Antonio and New Braunfels, with their mighty springs, and their ever clear and refreshing water, that are especially noteworthy; which places, if they were lying on the sea, would justly be called the Texan Nice.

RECENT LITERATURE.

WEBSTER'S ANNELIDS OF THE VIRGINIAN COAST.—The worms of the coasts of North America have been sadly neglected by American naturalists. The annelid fauna of New England has been pretty thoroughly examined by Prof. A. E. Verrill, but with this exception, a few scattered descriptions by Stimpson and Leidy, and one or two others, comprise the whole literature of the subject. We have in Prof. H. E. Webster's Annelida Chætopoda of the Virginian coast, a valuable contribution to the literature of this group. In this pamphlet of seventy-two pages the author has enumerated fifty-nine species, representing forty-nine genera and twenty-three families, of which twenty-seven species and four genera (*Lepidametria*, *Aricida*, *Cabira* and *Phronia*) are new. The work is illustrated by eleven lithographic plates in which the author's individuality has been preserved.—*J. S. K.*

RUTLEY'S STUDY OF ROCKS.[1]—This little work gives a very fair idea of lithology, as it is taught upon the European continent at the present time. It is for the English reading student the best and almost only source from which he can obtain an idea of modern lithology outside of the very few schools in which the subject is taught; Von Cotta's "Rocks Classified and Described" having been antiquated long before it was published.

Mr. Rutley's book bears marked evidence that its author "crammed" for the occasion, and shows, if anything, less originality than his published papers. Yet in spite of this "cramming" he seems to be ignorant even of the lithological literature of his own isle. It is to be considered as the work of a tyro, and not that of a master, like many of our ordinary text-books. The work is recommended to the American student because it is the only thing of its kind to be had, and hence is necessary to any student who cannot read German.

Some of its defects are the lack of any mention of Des Cloizeaux's method of determining the feldspars, or of Pumpelly's ingenious modification of it; of Streng's method of distinguishing nephelite from apatite, or of the monoclinic character of the micas as shown by Tschermak.

On page 179 the remarkable statement is made that the feldspars are the "principal rounded crystals in vitreous rocks." His vitreous rocks are removed from the rocks of which they are the glassy modifications; his trachytes range from sixty to eighty per cent. of silica, including both the rhyolites and the greater portion of the andesites; cherzolite and dunite are removed from their natural position; in fact, his classification is about as much without form and void as he could well make it. In describing the microfelsitic base (167), he, as well as the Ger-

[1] *The Study of Rocks.* An Elementary Text book of Petrology. By FRANK RUTLEY. H. M. Geological Survey. New York, 1879. D. Appleton & Co.

mans, have utterly confounded, under one name, that which is a product of a cooling magma, and that which is a secondary alteration product in rocks. On page 274 he states that "Petrology becomes the study of an endless cycle of changes from eruptive to sedimentary, and from sedimentary to eruptive rocks." A cycle of which the last half is neither sustained by field or microscopic research, nor by physics.

Such errors as picotite for pyrope (p. 141), chrysolite for chrysotile (p. 271) disfigure the work. Speaking of tridymite, on page 152, he says, "It has also been mentioned as occurring in some Irish rock, but the author is unable either to recall the precise locality or to find the reference."

Had he looked on the upper part of the same page[1] on which his own paper on tachylyte is published, to which he refers so often, he would have found it, as well as in numerous other scientific journals published in England and on the continent.—*M. E. W.*

Wright's Contributions to American Helminthology.[2]—In this paper of twenty-six pages and two plates, we have a valuable addition to our knowledge of the parasitic worms, which have been studied in this country by Leidy, Wyman, Verrill, Packard, Minot and Fitz. Thirteen species are enumerated, of which five are new. One new genus (*Sphyranura*) is proposed, while Leidy's genus *Clinostomum* is united with *Distomum*. In the descriptions of the species are included many anatomical facts; Minot's statement that the water vascular system and parenchyma spaces are connected in *Distomum* is confirmed. Some of the more interesting habitats recorded are *Polystomum oblongum* in the urinary bladder of the musk-turtle; *Sphyranura osleri* occurred in the mouth and gills of *Menobranchus lateralis*, *Tænia dispar* in *Rana halecina*. The round worm which was so prevalent in the shad last spring is referred by our author to *Ascaris aduncа* Rud. The two plates which illustrate the article are well drawn and printed.—*J. S. K.*

Scientific Results of the Chesapeake Zoological Laboratory.[3]—The speedy publication and finished nature of the papers in this volume speaks well for the industry shown by those who worked at this hastily equipped laboratory, and shows that elaborately constructed laboratories and expensive museums are not, from new and improved biological methods, essential to the real advance of biology in its widest sense. It will be remem-

[1] Journal of the Royal Geological Society of Ireland. New series, Vol. IV, Part 4, 1877.

[2] *Contributions to American Helminthology No. 1.* By R. Ramsay Wright. (Proc. Canadian Institute. New series, Vol. I, No. 1.)

[3] *Johns Hopkins University, Baltimore, Md. Chesapeake Zoölogical Laboratory.* Scientific Results of the Session of 1878. Organized and conducted by W. K. Brooks. (June 24 to Aug. 19, 1878) Baltimore, 1879. 8vo, pp. 170, 13 plates.

bered that Cuvier laid the foundations of his fame as a comparative anatomist at out-of-the-way spots on different points of the coast of France; Quatrefages made his most important researches on the coast in fishermen's houses, his tables of boards and his equipments most scanty. Better than elaborate and costly microscopes and laboratory apparatus is energy, industry and a mind well trained in the methods of research. All of these qualities are evinced in the publication before us, and is the result of workers trained in this country.

The contents, of what we hope will be the first of a series of similar biological contributions from the summer workshop of Johns Hopkins University, is an introductory giving an account of the foundation of the laboratory, to which the readers of this journal have already had their attention drawn. This is followed by papers on the Land Plants found at Fort Wool, by N. B. Webster; a list of animals found at Fort Wool, by P. R. Uhler; Development of Lingula, by W. K. Brooks; *Lucifer typus*, by Walter Faxon; Development of Gastropods, by W. K. Brooks; Development of Squilla, by W. K. Brooks. The paper on the early stages of Amphioxus, by H. J. Rice, has been delayed by the sickness of the author, and will be printed elsewhere at an early date.

Without disparagement to the other essays, that on Lingula will excite the most interest from the nature of the subject. The author, after a careful and fully illustrated study of the early stages of this shelled worm, as all must now regard it since Morse's discovery of its true relationship, concludes that the Brachiopoda are the most highly specialized representatives of the Polyzoön branch, the Rotifera, Polyzoa, and Veliger (a generalized form from which the different types of Mollusks are supposed to have diverged) having so separated at a very early period from a common vermian stem. "The three stems appear to be sufficiently closely related to each other, and sufficiently sharply distinguished from all other animals, to constitute by themselves one of the fundamental divisions of the animal kingdom, which might be called, on account of the conspicuous character of the trochal disc, the *Trochifera*."

Report of the Board of Commissioners of the Geological Surveys of Pennsylvania for 1878.—This document of four pages was printed for the use of the members of the Legislature, and is signed by Governor Hartranft, chairman of the Board. It conveys the information that twenty-four counties have been completely surveyed; thirty-one counties partially, and thirteen counties not surveyed. Thus a little less than half of the area of the State in counties has been surveyed, although actually rather more than half of the ground has been gone over. The most extensive continuous tract finished is that west of the Alleghenies and south of Crawford and Elk counties. The rapidity with which

the work has been done is expressed in the statement that "we have been able to publish each year reports of the work done the preceding year, an achievement which is believed to have been seldom accomplished in the history of Geological Surveys." The report states that two additional years will be requisite for the completion of the Survey, for which an appropriation of $100,000 is asked. On this we remark, that this request is a very modest one so far as the time required is concerned, and is probably made with the view of representing the survey in as economical a light as possible. The unfinished tract includes the most difficult ground; and will require relatively more time than that which has been completed: moreover no one supposes that the region reported as finished, could not be further elaborated with advantage to all the interests concerned. Again, the important department of palæontology has received little attention from the Survey, the only work so far done relating to the plants of the coal-measures. There should surely be complete monographs of the plants of other horizons, of the very numerous invertebrata and of the important remains of the *vertebrata* found at several horizons and various localities within the State.

RECENT BOOKS AND PAMPHLETS.—Haeckel's Genesis of Man. By Lester F. Ward, A.M. 8vo, pp. 64. Philadelphia, 1879.

Our Earliest Ancestors in Britain. By Prof. Boyd Dawkins. 12mo, pp. 95-105. (Science Lectures for the People, No. 6, 10th ser., 1878-9.) From the author.

Ricerche sui Pesci Fossili del Miocene Medio di Gahard (Ille-e-Vilaine) in Francia. Fr. Bassani. 8vo, pp. 30. Tav. I. Padova, 1879. From the author.

Notes on the Mesozoic of Virginia. By Wm. M. Fontaine. (From the Amer. Jour. Sci. and Arts, Vol. XVII, Jan. 1879.) 8vo, pp. 25-55. From the author.

Recherches sur les Oiseaux Fossiles des Terrains Tertiaires Inférieurs des Environes de Reims. Par M. Victor Lemoine. 8vo, pp. 69, pl. 4. Reims, 1878. From the author.

On the Range of the Mammoth in Space and Time. By W. Boyd Dawkins. (From the Quart. Journ. Geol. Soc. for Feb., 1879.) 8vo, pp. 138-147. From the author.

Note sur quelques Scincoidiens Nouveaux. Par M. T. Bocourt. (From Ann. Sc. Nat.) 8vo, pp. 4. From the author.

On a New Species of Loftusia from British Columbia. By Geo. M. Dawson. (From the Quart. Journ. Geol. Soc., Feb., 1879.) 8vo, pp. 69-75, pl. I. From the author.

On the Microscopic Structure of Stromatoporidæ, and on Palæozoic Fossils mineralized with Silicates, in illustration of Eozoon. By J. W. Dawson. (From Quart. Jour. Geol. Soc. Feb. 1879.) 8vo, pp. 48-97, pl. iii-v. From the author.

Notes on the Loess. By J. M. Witter. (From Muscatine *Tribune*.) Muscatine, Feb. 10th, 1879. 8vo. From the author.

Natural Science in Muscatine. By F. M. Witter. 8vo. Muscatine, March 24th, 1879. From the author.

Catalogue of Fossils found in the Hudson River, Utica Slate, and Trenton Groups, as exposed in the south-east part of Indiana, south-west part of Ohio, and northern part of Kentucky. By S. A. Miller. (From 10th Ann. Rep. Geol. Surv. of Indiana.) March 1879. 8vo, pp. 35. From the author.

Notes on the Glaciation of British Columbia. By Geo. M. Dawson. (From the Canadian Naturalist, Vol. IX, No. 1.) 8vo, pp. 8. From the author.

Characeæ Americanæ. By Timothy F. Allen. 4to, pt. 1, pp. 1, pl. 1. New York. From the author.

A few Last Words on Chara. By Alfred W. Bennett. (Ext. Jour. Bot. March, 1879.) 8vo, pp. 2. From the author.

Morphological notes on the Limbs of Amphiumidæ, as Indicating a Possible Synonymy of the supposed Genera. By John A. Ryder. (Proc. Acad. Nat. Sci.) Jan. 1879. 8vo, pp. 2. From the author.

Further Notes on the Mechanical Genesis of Tooth Forms. By John A. Ryder. (Proc. Acad. Nat. Sci.) 8vo, pp. 47-51. Philadelphia, 1879. From the author.

Notes on the Fishes of Beaufort Harbor, North Carolina. By David S. Jordan and Charles H. Gilbert. (Proc. U. S. Nat. Museum.) 8vo, pp. 365-388. From the author.

Della Balena di Taranto confrontata conquelle Della Nuova Zelanda econ Talune Fossili del Belgio e Della Toscana notizie del Prof. Comm. G. Capellini. 4to, pp. 34, pls. 3. Bologna, 1877. From the author.

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Proceedings of the Boston Society of Natural History. Vol. XX, Part I, May to November, 1878. 8vo, pp. 112, pl. 1. Boston, 1879. From the society.

Le Naturaliste, 1er Annee, No. 1, April, 1879, Paris. 4to, pp. 8. From the editor.

Bulletin of the American Meteorological Society. Constitution and By-laws, etc. 8vo, pp. 11. New York, 1879. From the society.

The Naturalists' Leisure Hour. Nos. 4 and 5, 1879. From the editor.

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A Century of Orthoptera. By Samuel H. Scudder. (From the Proc. of the Boston Society of Natural History, Vols. 12–20, 1879.) 8vo, pp. 83.

Studi sui Ragni Malesi e Papuani. Per T. Thorell II. Genova, 1878. 8vo, pp. 313.

Traces of an Early Race in Japan. By Edward S. Morse. (Reprinted from the Popular Science Monthly for January, 1879.) 8vo, pp. 10, illustrated.

Transactions of the Kansas Academy of Science, 1877 and 1878, Vol. VI. Topeka, Kansas, 1878. 8vo, pp. 92.

Pelagic Amphipoda. By Thomas H. Streets, M.D., U.S.N. (From the Proc. of the Academy of Natural Sciences of Philadelphia.) 8vo, pp. 15, 1 plate.

Scientific Results of the Exploration of Alaska. Article IV. Report on the Limpets and Chitons of the Alaskan and Arctic regions, with descriptions of genera and species believed to be new. By. W. H. Dall. (Bulletin U. S. National Museum, 1.) 8vo, pp. 64, 5 plates and illustrations.

Phryganiden-Studien von Fritz und Hermann Müller. From Kosmos II, Jahrg. Heft 11.) 8vo, pp. 11, illustrated.

Einstämmiger und Vielstämmiger Uhrsprung. Von Ernst Haeckel. (From Kosmos.) 8vo, pp. 17.

Ueber die Organization und Classification der Anthromedusen. Ueber die Organization und Classification der Leptomedusen. Von Ernst Haeckel. (Separat-Abdruck aus den Sitzungsberichten der Jenaischen Gesellschaft für Medicin und Naturwissenschaft. Jahrgs 1878–1879.) 8vo, pp. 7.

Notes on some Sections of Trilobites from the Trenton Limestone, and Descriptions of new species of Fossils. By C. D. Walcott. (Ext. from the 31st Report on the New York State Museum of Nat. Hist., Albany, March, 1879.) 8vo, pp. 13, 1 plate.

Descriptions of new species of Fossils from the Calciferous formation. By C. D. Walcott. (From the 32d Annual Report of the N. Y. State Museum of Nat. Hist., Albany, Jan., 1879.) 8vo, pp. 4.

Mélanges Orthoptérologiques. Par Henri de Saussure. VIme Fascicules. Grylllides 2me Partie. Genève 1878. 4to, pp. 328, 4 plates.

On the Anatomy of Ocherodrilus. By Gustaf Eisen. (Presented to the Royal Society of Upsala, the 11 Mai, 1878.) 4to, pp. 12, 2 plates.

The Early Types of Insects: or the Origin and Sequence of Insect Life in Palæozoic Times. By Samuel H. Scudder. (Memoirs of the Boston Society of Natural History, Vol. III, Part I, No. II, March 6, 1879.) 4to, pp. 9.

Les Arachnides de France. Par Eugène Simon. Tome quatrième. Contenant la famille des Drassidæ. Paris, 1878. 8vo, pp. 336, 5 plates.

Exotische Microlepidoptera. Beschrieben von Prof. P. C. Zeller I, II. St. Petersburg, 1877. 8vo, pp. 491, 6 plates.

Ueber die Goethe'schen Worte. "Leben ist die schönste Erfindung der Natur und der Tod ist ihr Kunstgriff viel Leben zu haben." Rede beim Antritt des Rectorats an der Königlichen Universität zu Kiel gehalten am 5 März, 1879. Von Dr. Karl Möbius. Kiel, 1879. 4to, pp. 14.

Samuel Butler's Gedanken über die Rolle der Gedächtniss-Uebung in der Entwickelungsgeschichte. Von Dr. Hermann Müller. Kosmos III, Jahrg., Heft I. 8vo, pp. 15.

Notice of Recent Additions to the Marine Fauna of the eastern coast of North America, No. 3. By A. E. Verrill. Brief contributions to zoölogy from the museum of Yale college, No. XL. (From the American Journal of Science and Arts, Vol. XVII, March, 1879.) No. 4, April, 1879. 8vo, pp. 14.

On the Complete Series of Superficial Geological Formations in North-eastern Iowa. By W. G. McGee. (From the Proc. of the Amer. Asso. for the Advancement of Science, Vol. XXVII, St. Louis meeting, August, 1878.) Salem, 1879. 8vo, pp. 34.

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GENERAL NOTES.

BOTANY.

DAVENPORT'S CATALOGUE OF THE DAVENPORT HERBARIUM.[1]—This is a catalogue of the Davenport Herbarium of North American Ferns of the Massachusetts Horticultural Society, which contains specimens of every authentic species of the ferns at present known to inhabit North America, north of Mexico, consisting of thirty-two genera representing one hundred and forty-two species. The catalogue is a valuable addition to our botanical literature, and also timely, as an unusual degree of interest is now bestowed by collectors to ferns. If all would pay as much attention to the young stages and specific limits of

[1] *Catalogue of the Davenport Herbarium of North American Ferns north of Mexico.* Massachusetts Horticultural Society. Published by the author, Salem, Mass., 1879. 8vo, pp. 42. 50 cents. Address the author, George E. Davenport, Medford, Mass.

these beautiful plants as Mr. Davenport, and should this mode of study be extended to the higher plants, botanical science in this country would take a much higher stand than it now does, as collecting, cataloguing and the framing of local lists is but preliminary to the genuine study of the life-history, classification, genealogy and physiology of plants.

GOODALE'S CONCERNING A FEW COMMON PLANTS.—This is a small 16mo of 61 pages, issued as one of the Guides for Science Teaching, published by the Boston Society of Natural History. It is used by the teachers of the public schools of Boston, who to the number of five hundred attend the Teachers' School of Science of this popular society. The present little work is a most successful effort to induce teachers to qualify themselves for giving to their pupils a series of object lessons in elementary botany.

ALLEN'S CHARACEÆ AMERICANÆ.—This is the first part of what will prove a most useful monograph of our American Charas. It is published by the author, Dr. Timothy F. Allen, 10 E. 36th street, New York. A colored plate and a page of text form Part I.

BOTANICAL NEWS.—The *Bulletin* of the Torrey Botanical Club for January and February contains a synopsis of discoveries and researches, in 1878, on fresh-water Algæ, by F. Wolle. In the March number Prof. Eaton describes a new Hawaiian fern, and Arthur Hollick contributes a few notes on the abnormal absence of color in plants.——In the *Botanical Gazette* for April, J. D. Smith records the occurrence of a tropical plant, *Ophioglossum palmatum*, on the west coast of Florida; Mr. C. F. Austin describes a number of new mosses. The number for May contains, among others, Notes on some rare plants, by W. Canby; On yellow snow, by T. C. Porter, and Descriptions of some new mosses, by C. F. Austin.——Notes on Californian fungi, by M. C. Cooke, appear in *Grevillea* for March.——Trimen's *Journal of Botany* for April, contains an article on the sources of Chinese matting, by H. F. Hance.——The relation of forests to rainfall is discussed by Prof. J. E. Todd in the Iowa Horticultural Report for 1878. He believes with others that the growth of trees may increase the rainfall, and does not fear that the future forests of Iowa will ever seriously suffer from drouth.——We have received from Dr. Hermann Müller a pamphlet giving farther observations on the fertilization of flowers by insects. (Extracted from the Trans. of the Natural History Society of Prussian Rheinlands and Westphalia, xxxv, Bd. v.)

ZOÖLOGY.[1]

SYNONYMOUS UNIOS.—The following synonomy is based upon series of shells received from Prof. Witter, Muscatine, Iowa, and Dr. J. Schneck, Mt. Carmel, Ill., purporting to be *Unio nasutus*. That both series represented the same species was beyond doubt, but that it was *U. nasutus* was as plainly to be doubted. From obvious resemblances they were compared with *U. nashvillensis* Lea, and *U. mississippiensis* Con., and the several series were found to be identical, and it was further established that none of them were *U. nasutus*. The comparison was based upon the position and form of the cicatrices, the size, position and angulation of the teeth, crenulation of the lateral teeth, color of the nacre and of the epidermis (after treatment with oxalic acid to remove ferruginous matter). Then came the query, "which is which?" The western collectors all call the shell *U. nasutus*, which is evidently incorrect. *Nasutus* is a flat, slender shell, and, like *U. complanatus*, belongs to the Atlantic slope, though both Mr. Lea and Mr. Say assert that "the species inhabits the western waters."

Mr. Lea in his Synopsis of the Unionidæ, p. 60 (note on *U. iris*), himself points out a possible solution. He says, "As the *U. nasutus* inhabits the western waters, a variety of that species may have been described by him (Mr. Say) for *subrostratus*." Here a thought suggested itself that both Mr. Lea and Mr. Conrad had described a *new species*, varieties of Say's older *subrostratus*. In my perplexity the shells were submitted to my friend Dr. Lewis, of Mohawk, N. Y., for further study and correction. We compared them with Say's description of *subrostratus*, with typical series of the other species mentioned above, and they were pronounced by him to be identical. Subsequent to this, after my arrival again East, Dr. Lewis writes (May 17, 1878), "I have got to the bottom of the synonomy of the shells you had from Dr. Schneck. He and many of the western collectors call the shell *wrongly U. nasutus* Say. It is *U. subrostratus* Say. Add to it the synonomy of *U. nashvillensis* Lea, and of *U. mississippiensis* Con., and you have it all complete." He further says, "Mr. Lea makes *subrostratus*--a synonomy of *iris*. Lea followed Say, who was in error as to what was *iris*, which it is clear he had not seen." Say's *subrostratus*, therefore, stands as a good species, and, because of its priority of publication (1831), we must write as its synonyms *U. nashvillensis* Lea, and *U. mississippiensis* Con.

There is a marked difference in the outline of the shell in the sexes of all these species. Nor is this difference without marked prominence in the same sex, which, as Gegenbauer has shown (Comp. Anat., p. 318), must be regarded as caused by the relative positions of the various organs. Every one, who has dissected any great number of Unios, knows full well the differences in rela-

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

tive position of the various organs. It is more than probable that these differences result in a modification of function, and of so marked a nature that the external characters may be sensibly changed.

Notwithstanding the work already done in the direction of synonomy, when a more complete knowledge of the anatomy of Unio is attained, and more is known of the modifications due to range and station, the number of species names will be sensibly diminished. This work will lie almost wholly in the line of their comparative anatomy and embryology. Not one organ, but all, must receive their due attention, then the external expression of these organs will be far more clearly comprehended.—*P. Ellsworth Call.*

The Westward Progress of the Imported Cabbage-worm.—In 1869, in my second report, in treating of this insect, I remarked, "There is every reason to fear that it may some day get a foothold in our midst," after showing that it was then confined to certain restricted parts of Canada and New England, and had not spread west of New York. It has been making further progress westward every season since. The past year it has done considerable damage as far west as Chicago, and I have also received good testimony that it was observed around St. Louis. I have given my reasons, in the report referred to, for believing that it will prove much more disastrous to the cabbage-fields around St. Louis than the Southern cabbage-worm (*Pieris protodice*), which has always been with us, and has done, at times, considerable damage, and I refer those who wish to be prepared with a full knowledge of the habits of this species, to that same report.

As remedies, few liquids will prove more effectual than hot-water, judiciously applied, though one pound of whale-oil soap dissolved in about six gallons of water, or even strong tar-water may be used to advantage. The application should be made several times during the year, as it will be most effectual when the worms are young.

As preventive measures, the worms may be induced to transform under flat pieces of board laid upon any object that will raise them about an inch from the surface of the ground. These boards should be examined every week, and the transforming larvæ or the chrysalids destroyed. The butterflies may also be captured by hand-nets and prevented from laying their eggs.—*Prof. C. V. Riley before the Mo. State Hort. Soc., Jan.* 1879.

Parthenogenesis in the Honey-bee.—In the article in the April American Naturalist, p. 261, copied from the *Comptes Rendus*, we have illustrated the danger of hasty generalization. The writer of the article suggests that the "Dzierzon Theory" rests on insufficient observation. This is far from the truth. The closest observation not only by German but also by many American apiarists, not only of one queen and her progeny, as was the

case with the author of the article, but of hundreds, has placed Dzierzon's theory on a certain basis. The writer says, referring to his single hive, "from this it is evident that the drone eggs, like those of the females, receive the contact of the semen deposited by the male in the female organs."

It is well known that virgin queens will lay eggs that will produce exclusively male bees. I have seen several such cases. I have known queens reared late in autumn to pass the winter as virgins and ever after to produce only male bees. Deformity of the queen, or clipping her wing while yet a virgin, so that she may be unable to take the "marriage flight," precludes mating, and as surely makes a "drone laying queen." Old queens with shriveled spermathecas are often drone layers.

How did the writer know his queen in question was not a hybrid? He could not know. Many hybrid queens are to all appearance perfectly pure. Again, how did the writer know that the drones were hybrids or blacks? Frequently the drones of our queens imported right from Italy, like the queens, are almost as dark as the drones of the German race, yet the three banded workers show the queen to be pure. One case alone, however striking, should not be regarded as fatal to so well established a theory. The case given, so far as given, is no evidence against parthenogenesis of the drone bees.—*A. J. Cook.*

Perez' paper in the *Annales des Sciences Naturelles* for April, 1878 (only just received), is followed by one published in June, 1878, by A. Sanson, who thinks that Perez goes too far in qualifying the insufficiency of the observations of Dzierzon, and who has not given the most exact interpretation to his own (Perez) observations. The view that the honey bee is parthenogenetic is confirmed by the fact that a number of other insects are produced from unfertilized eggs; besides Mr. Sanson believes that the hybrids produced in Perez' hive were the result of the action of the law governing the reproduction of hybrids of all kinds, in the different branches of the animal and vegetable kingdoms, and which recognizes ancestral influences, atavism, the reversion to characters not existing in the immediate parents. In truth, the queen manifested the law of heredity which is observed in all hybrids. She had the external characters of the pure Italian, at least those of color; coupling with a brown male the eggs it laid gave birth to workers of varied characters such as exist in all hybrids. Sanson also criticises adversely the views of Gerard based on the observations of Perez. Gerard admits that in the hive examined by Perez, there were workers which laid eggs. Sanson doubts whether careful observations would have shown the co-existence in this hive of fertile queens and workers.—*Editors Naturalist.*

The Anatomy of the Anthropoid Apes.—This subject has received some interesting contributions from the recent investiga-

tions of Drs. Chapman and Parker of Philadelphia. Dr. Chapman dissected a young gorilla which belongs to the Museum of the Academy of Natural Sciences, and a young chimpanzee which had been living in the Zoölogical Gardens of that city. The observations on the gorilla relate chiefly to the muscular and circulatory systems. Dr. Chapman found in the anterior limb a distinct extensor primi internodii pollicis muscle, but no trace of flexor longus pollicis. He also observed an artery not previously described, which is given off from the femoral from the middle of its course, and accompanies the long saphenous nerve and vein to the inner aspect of the foot. While admitting that this vessel may be anomalous, its size and importance, and presence on both sides, lead Dr. Chapman to propose for it the name of the long saphenous artery. The same writer, in his observations on the brain of the chimpanzee, finds that the posterior lobe of the cerebral hemisphere does not cover the cerebellum, in accordance with the view of Professor Owen. Dr. Parker's investigations lead him on the other hand to the opinion that the posterior lobes do cover the cerebellum as stated by Prof. Huxley.

On a Difference between the Rana esculenta and other species of Batrachians.—In July, 1877, while engaged in a series of experiments on the effect of dry and moist heat on animals previously subjected to various operations, I found that not one of my frogs responded to dry heat applied to any portion of the skin. The application was made with a red or white-hot metal rod. This was so surprising a result that it seemed very probable that it depended on some peculiarity of the Batrachians experimented upon. The observations were made on the *Rana clamitans* and its ally, *R. pipiens*, and were continued unconnectedly until June, 1878, up to which time I had not found a frog in whom the heated rod acted as a sensory irritant. Burning the sensory nerves failed to produce any movements, the motor nerves however were excitable for this method of irritation.

After my return to Geneva, in July, these experiments were continued on the *Rana esculenta* with the same result. In August some *Rana temporaria* were obtained from Berne. These were found to be very sensitive to dry heat. This sensitiveness remained when the heated rod was applied underneath the skin. The nerves also were very readily excited by dry heat. At the same time the *Rana esculenta* from the same locality were so insensible to dry-heat that they would allow themselves, though free to move, to be burned to a crisp in the reducing flame. The same experiment could not be made with a *Rana temporaria*, as these animals jumped away as soon as the heat became uncomfortable. These observations were found to hold good of animals without as well as of those with brain and medulla oblongata; of those in whom the skin had been dried as well as in those in which this organ was moist; in females as well as in males.

Hyla viridis, *Bombinator igneus* and *Bufo calamita* were all sensitive to dry-heat applied to the skin or sensory nerves.

The frogs examined in September gave the same result as those examined previously. In the beginning of October, in several *R. temporaria* the skin was found to be no longer sensitive to dry heat, the sensory nerves, however, remained sensitive to this irritant. The *Rana esculenta* were as in the previous month.

The first week of November the temperature was almost continually below the freezing point. On examining the sensitiveness for heat, I found that the *Rana esculenta* had become quite sensitive to impressions of heat. The frogs of the *temporaria* species had at the same time their sensibility for this irritant greatly reduced. At this time I received, through the kindness of my friend Mr. Richard Lomer, who assisted me in quite a number of my experiments, a number of frogs from Heidelberg. At Heidelberg Mr. Lomer found that the skin of the *Rana esculenta* could be irritated by dry heat, while that of the *Rana temporaria* could not.

Immediately on their arrival these frogs were examined, and both varieties were found to be sensible to heat, though the frogs of the *esculenta* species responded much slower than the *temporaria*. At the moment of writing (Nov. 23d) almost all the *Rana esculenta* are insensible to heat. They become sensitive to this agent when their brain has previously been destroyed. Though this is true of the terminations of the sensory nerves in the skin, it is not true of the nerve trunks, these always remaining insensible.

All the varieties of Batrachians that I have thus far examined, appear to be sensible to moist heat from 35° C. upwards.

As it is impossible for me to continue these observations on but a very limited number of Batrachians, it would afford me great pleasure were any of the readers of the AMERICAN NATURALIST, many of whom have such excellent opportunities for such researches, inclined to assist me in these investigations. It would be of great interest to know in all these examinations the locality, the time of the year and the temperature of the surrounding atmosphere in which the experiments are made.—*B. F. Lautenbach, Geneva, Switzerland, Nov.* 23, 1878.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The third number of the *American Antiquarian* contains the following papers: Native American Architecture, by E. A. Barber; The phonetic elements in American languages, by Dr. J. A. Farquharson; The inscribed stone at Grave Creek mound, by Prof. M. C. Read; Traces of Bible facts in the traditions of all nations, by Rev. Stephen D. Peet; Mythological text in the Klammath language, with comments by A.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

S. Gatschet. Nearly one-half of the number is occupied with correspondence and notes that are quite as valuable as the more extended articles, if the authors of the latter will pardon us. It should be well understood that very few of our special periodicals are paying expenses. In order to keep them alive, therefore, the friends of that branch of knowledge must make sacrifices to sustain them. So let it be with the *Antiquarian.*

We have received from the author, Mr. John Campbell, M. A., Montreal, a pamphlet entitled, "The affiliation of the Algonquin languages." The paper is supplemented with a linguistic chart showing the supposed affiliation of the Algonquin tongues with the Malayo-polyenesian, Ural-altaic, Asiatic-hyperborean and Peninsular languages.

The volume containing the report of the forty-fourth session of the Congrès Archeologique de France, held at Senlis, in 1877, is devoted principally to that branch of archæology which is outside of our area. There are a few interesting illustrated papers on the prehistoric archæology of France which will pay the perusal.

The first and the second fasciculus of the *Bulletins* of the Société d'Anthropologie de Paris, for the year 1878, contain very valuable matter of general import.

On page 13 Paul Bert speaks of barometric pressure as a factor in civilization, on the occasion of presenting his book entitled: La Pression Barometrique, recherches de physiologie expérimentale.

On page 56 is a communication, by M. Coudereau, upon the precocity of development in relation to nourishment. At the close of the article is a series of questions which M. Condereau proposes to be put in the hands of travelers.

The article by Dr. P. Topinard on the insertion of the hair of negroes in tufts is as interesting as it is original. We make a few extracts from it. "The fundamental division of the human races into two branches rests, by common consent, upon the characteristics of the hair; of this classification Bory de Saint-Vincent is the author. The first branch contains the races with straight hair, the second, the races with woolly hair."

There is a subdivision of the second branch made by M. Haeckel, and generally accepted. It depends upon the manner in which the woolly hair is distributed over the surface of the body and more particularly of the head. In one case their insertion is continuous, like the straws in a field of wheat. In the other it occurs in bouquets, or isolated tufts, having between them free spaces where the skin is glabrous. M. Haeckel calls the former *eriocomi*, the latter *lophocomi*. The origin of this character, of such great importance, if it is true, goes back to Barrow, at the commencement of this century. The Hottentots, said he, have hair of a singular nature; it does not cover the head totally,

but is in little tufts a small distance from one another. When they cut it short it resembles a shoe-brush, with this difference that the tufts are twisted into little knots the size of a pea. The same assertion is made by travelers concerning other negro races.

But as far as my observation goes, the character according to which M. Haeckel and others cut into two subdivisions, the grand branch of negroes does not exist at all. Among all the negroes the hair grows uniformly upon the surface of the head and of the body. Among all there are tufts. But these tufts are not indicated upon the skin. The hair of the negro varies in aspect more than people ordinarily imagine, as Hombron was one of the first to remark. It is presented under three principal forms, between which there are all sorts of intermediary groups.

The first is the typical form, which characterizes most generally the inferior negro races, to which the Hottentots belong; it is the arrangement of the hair called "grains of pepper." This appearance is produced by the shortness, the turns of the spirals being very close and giving rise to very narrow coils or rings, perhaps 2–4 millimetres; by the hairs being very numerous; and finally, by the total abandonment of the hair to itself.

The second is in the form of locks twisted in curls, small or large, from 6–8 millimetres in diameter; locks which one might speak of as *tufts*, but much elongated, at times reaching 25 centimetres (Fritsch). Evidently Barrow meant this, when speaking of certain Hottentots, "when they let their hair grow, it falls on the neck in twisted tassels, somewhat like fringe," this form and the preceding Bonwick observed among the Tasmanians.

The third form is presented in the shape of a cushion or compact mat, more or less large, elastic, returning to its original curl when compressed with the hand. It is a distribution of the hair in which the spirals are mixed, confounded without the least appearance of order. It is encountered most frequently in the negro races with long hairs and at the same time with less savage races who take some pains with their toilet. It is in this form that we meet these bizarre coiffures, described by travelers among the Caffres, Mpongwes, Somalis, Papuans, etc.

These same hairs, sufficiently abandoned to themselves, return to the preceding form with more or less facility.

Finally, taking into account my own experience, and after attentively reading the travels describing the Hottentots, Papuans, and other negroes, I conclude that the division of the woolly-haired races by M. Haeckel into *lophocomi* and *eriocomi* is without foundation. On page 94 will be found the report of a committee consisting of MM. Bordier, Topinard and Bertillon, to examine a negro in one of the hospitals.

GEOLOGY AND PALÆONTOLOGY.

THE TERTIARY ERUPTIVE ROCKS.—The trachytic formation is a most interesting one, but also very complicated. Hungary may be considered as the cradle of our notions respecting it since the time of Beudant. Richthofen imported the classification to California as it was established about eighteen years ago, based chiefly on habitus-characters. The geologists of the Vienna school have continued the study of it, and about some twelve years ago they published the geological map of Hungary too, also showing the considerable progress made since the departure of Richthofen.

The geologists of the 40th parallel have accepted as a base the classification of Richthofen, but with some alterations suggested by Zirkel; and that is about the classification adopted by Endlich and the other geologists of Prof. Hayden's staff, with the only difference that they have abandoned the propylite.

Owing to the method employed, the petrographical part, as regards the feldspars, the true base of classification is incomplete: firstly, the plagioklastic feldspars are not distinguished specially; secondly, every glassy feldspar has been taken for (potash) sanidine, which is not the case.

In Hungary and some adjacent countries, the trachytes have been the object of my detailed studies nearly since Richthofen's time. I commenced as field-geologist, and have continued as such, but making the aid of petrography serviceable to my field-work. I came to the conviction that those two branches of investigation are contributing to the appreciation of the true nature of the eruptive rocks in a surprising manner; the mineralogical association also agreeing with the chronology of the eruptive rocks belonging to the same cyclus of eruption.

If you have no objection I will give a sketch of my classification of the Tertiary eruptive rocks:

1. *Basalt, Leucitite.*

2. *Augite—Anorthite, Trachyte* (no quartz, no biotite). This in its normal state is the porphyre trachytique of Beudant, the andesite of Buch, the augite of German geologists; in its modified state it can take up the habitus of greenstone (augite propylite), and in other circumstances it may become basaltic, but it is never rhyolitic.

3. *Biotite—Amphibole-Labradorite Trachyte.* Without or with quartz, without or with augite.

In its normal state it may belong to the "echter trachyt" of the Austrian geologist, or to the amphibole-andesite. It can take up the greenstone (amphibole-propylite), or the basaltic, and very imperfectly the rhyolitic modification.

In some Hungarian trachytes of this type the garnet occurs in the mineralogical association, apparently replacing the lime-feld-

spar. Of two labradorite-trachytes of the same country, the one being with, the other without garnet, the latter is younger.

4. *Biotite-Amphibole Andesin* (*oligoclase*) *Trachyte.* Without or with quartz, without or with augite.

In its normal state it may belong partly to the "echter trachyt," or to the amphibole-andesite; in its modified state it passes in some cases to greenstone (propylite), rarely to basalt (oligoclase basalt), but by taking up a pearlitic and sphærulitic structure, often to rhyolite.

5. *Biotite Orthoclase* (plagioclase) *Trachyte.* Without or with quartz; without or with amphibole.

In a normal state it may have the appearance of syenite or granite; in its modifications the rhyolitic in the highest degree (pearlite, pitchstone, obsidian) is often met with.

In Hungary volcanic activity also ended in an outburst of basalt, and it is convenient to give to it a special color on the map, though its formation may be regarded as an episode accompanying nearly every one of the four periods, so that not only the augite-anorthite trachyte has been followed by a basaltic outflow, but after the close of the biotite labr. trachyte eruption, an outburst of basalt took place also, in which some of the associated minerals of this trachytic type may be recognized; and so there may have been basaltic eruptions at the end of the biotite-andesite, and rarely of the orthoklase trachyte too; but such distinctions not being observable in the field, the custom of uniting them in the geological map is to be maintained.

The leucitite is closely allied with the orthoclase-trachyte; in Italy it is always to be found in the region of orthoclase-trachyte. It is a kind of basic modification of the biotite orth. olig. trachyte. It can be colored as basalt with some additional mark.

The greenstone modification has been produced originally by solfataric, and subsequently by metamorphic and still existing action. The rhyolite is the modification of an older acid-trachyte, in most cases of the biotite orth. olig. trachyte (with or without quartz), produced by submarine activity of a newer basic trachyte breaking up under it. The orthoclase being more easily fusible than the labradorite or the (nearly) infusible anorthite, and having the property of forming very fusible hydrosilicates much more easily than all the plagioclastic feldspars, is converted into the glassy hydrated compounds (rhyolites). Every rhyolite indicates the contact with a younger trachyte of a more basic character, in most cases with the augite-trachyte. The rhyolites may be of a different age, because every one of the three younger trachytic periods can have produced this modification; but the most characteristic pearlites and obsidians have, of course, been formed in the newest period of the trachytic eruption.

In such regions, where after the outflow of biotite orth. trachyte no new eruptions ensued, no rhyolite is to be found; the biotite

orth. trachyte occurs in its normal porphyritic, syenitic or granitic state.

On the map the greenstone-trachyte (propylite) and the rhyolite, as important habitus-characters, are to be signalized by a secondary mark on the respective trachytes.

The chronological order has been established by means of the sedimentary formations formed wholly or partly by trachytic ejections, aided by the breaking of younger trachytic masses through older ones, in which case in the region of contact the minerals of two different types may be found mingled.

The trachytic types as enumerated according to their order of basicity, exhibit at the same time also the chronological series of the eruptions. The limits of time for the trachytic formation in Hungary are the following:

1. The eruption of the augite-anorthite trachyte took place in the Upper Miocene (Sarmatische Stufe).
2. The biotite-amphibole labradorite trachyte corresponds to the Middle Miocene (Mediterranean Stufe).
3. The biotite-andesite (oligoclase) trachyte appeared during the Lower Miocene.
4. The biotite orthoclase trachyte is the product of the beginning of the trachytic cyclus of eruption during the Upper Eocene.

For the field-geologist, who visits a country for the first time, such a detailed classification is of course impossible; he must be contented with a general one, but one which should still be in accordance with the former. He may arrive at that by means of some microscopical minerals, some habitus properties, aided in many cases even by panoramic characters of the single trachytic types, all that being taken into consideration not only on the eruptive rocks themselves, but also on the sediments containing trachytic fragments.

Two classes are easily distinguished: the augite-trachyte and the biotite-amphibole trachyte; the former is the younger, the latter the older. Since the time of Beudant, the "trachyte micassé amphibolique" has maintained itself and is well characterized by the microscopical minerals mentioned.

With the aid of rhyolites three classes can be established: the oldest trachyte being the biotite orthoclase (quartz) trachyte. The presence of pearlite and other glassy modifications involves two distinct types of trachytes; the rhyolite is the transformation of the older acid type by a younger one of a more basic feldspar, which remains in some cases concealed under the cover of the rhyolite, while in other instances it breaks through it. On the line of contact the highest degree of rhyolithism is perceptible, while with the increasing distance the normal state is more and more preserved.

The general features of these three classes are so prominent, that once acquainted with them, they are to be discovered every-

where, notwithstanding the varieties, which are indeed numberless, but which do not exercise any influence on the fixed characters needed for the above classification.

The order of eruptions is the same not only in Hungary, but down southward as far as to the region of the active volcanoes of Italy and Greece. Vélain has found it so on the isle of Reunion; Professor Heddle Forster informs me, that in the Tertiary volcanos of the Hebrides the first out-flow is a granitic rock with orthoclase, the second an augitic rock with labradorite, the third amygdaloids and basalt with labradorite. The admirable work just issued, "Santorin et ses eruptions," by Fouqué, confirms this order also for that volcanic island; the amphibol-labradorite, more acid rocks are older, the augite labradorite-anorthite more basic rocks younger.

There is no doubt, that the trachytes of the Rocky Mountains will follow the same law; but as regards the limits of time, the cyclus of eruption may exhibit a difference in the relative age. It could have begun sooner in one country, and later in another, corresponding to distinct volcanic basins, formed in different times. As regards the cyclus of trachytic eruptions in Hungary, and in the western part of the United States, there are many indications that lead me to adopt the opinion that our cyclus antedates yours.

In order to enable us to pursue more extensive comparative studies, descriptions are not sufficient; the objects must be seen too, at least samples of rocks should be at our disposal. You are very generous and liberal, whenever the interests of science are in question; may I ask you to let me have some of your duplicates of typical rocks.

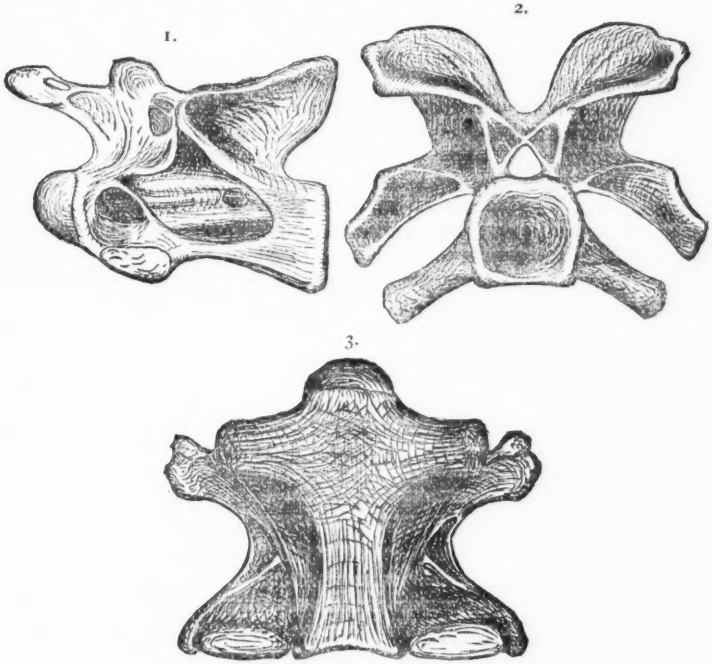
We have in Hungary a beautiful series of pliocene, miocene and eocene rocks, and so the age of eruptions can be well settled. Your series seems far from being so clear, and so complete, the connection between the trachytic series and the sedimentary formations is consequently not so evident.

I should like very much to have samples of your marine clays and sands of miocene and eocene also. Professor Hantken, the director of the Hungarian Geological Institut at Budapest, is the specialist for the nummulites, orbitoides and Foraminifera generally. It would be very good for science, if he could have an opportunity to make comparative investigations; while on the other hand, I could ascertain whether traces of volcanic sand are contained in them.—*Dr. Joseph Szabó, Prof. of Min. and Geology in the University of Budapest.* (*Extract from a letter to Prof. Hayden.*)

New Jurassic Dinosauria.—A second species of *Camarasaurus*, from the Jurassic of Colorado, is indicated by three cervical vertebræ, and probably by other remains in my collection. The dimensions of these specimens are a little less than that of the largest neck vertebræ of the *Camarasaurus supremus*, but the average length is not very different. The proportions are charac-

teristic. The centrum is little depressed, the vertical and transverse diameters of the cup being nearly equal. The form is thus much more slender than in the *C. supremus*, indicating a neck somewhat like that of the *Trionyches* or *Chelodinæ*.

The parapophyses descend backwards and downwards from the edge of the anterior ball; they are much shorter than the diapophyses, which are decurved. The side of the centrum and coössified base of the neural arch are excavated by a large fossa, which is somewhat subdivided. A smaller fossa is in front of it above the parapophysis. Still another divides the posterior base of the neurapophysis, on each side of the neural arch. The posterior



EXPLANATION OF CUTS.

Cervical vertebra of *Camarasaurus leptodirus*, one-tenth natural size. 1, right side; 2, posterior end; 3, inferior surface. Fig. 1 is taken from one vertebra; figs. 2 and 3 from another.

zygapophyses support a strong superior crest, and their superior edges converge to meet at an angle without forming a neural spine at or posterior to the middle of the length of the neural arch, as is the case in *Epanterias amplexus*. The external bases of the zygapophyses are excavated deeply. Length of centrum m. .430; vertical diameter of cup, .140; transverse do., .160;

expanse of diapophysis, .380; of posterior zygapophyses, .450; elevation of do., .250; elevation of do. with crest, .360. The species is named *Camarasaurus leptodirus.*

Bones of an allied species recently received from Colorado, represent a most gigantic animal. The transverse diameter of the cervical vertebra is fifty-six inches, and that of the distal end of the femur, twenty-one inches.

A species of the carnivorous Dinosaurian genus *Hypsirhophus* has lately been received from another locality, which adds considerably to our knowledge of it. Vertebræ, limb bones and teeth found together, confirm the correctness of my supposition as to the true affinities of the genus.[1] The animal obtained is about the size of the *Hadrosaurus foulkei.* The dorsal vertebræ display the zygapophysial mass greatly elevated on a stem which has a quadrate section, with anterior and posterior grooves. There is no hyposphenal articulation. The diapophyses are wider than deep, are directed obliquely upwards from the superior margins of the zygapophyses, and have a prominent anterior superior border; the neural spine is short and compressed. The centrum is amphiplatyan and moderately compressed at the middle. The caudal vertebræ are not very elongate, and have a compressed hexagonal section. The chevron facets are on produced bases. Many of the teeth are less compressed than usual with Megalosauroid species, and have two denticulate edges. Length of dorsal centrum m. .100; vertical diameter of do., .084; transverse diameter of do., .073; elevation of postzygapophyses from centrum, .122; elevation of neural spine above centrum, .292; length of diapophyses below, .130; length of a caudal centrum, .048; depth in front .050; distal width of femur, .250. I name this species in honor of my friend Professor Seeley, *Hypsirhophus seeleyanus.—E. D. Cope.*

GEOGRAPHY AND TRAVELS.[2]

African Exploration.—To the account given in our last number of the various expeditions engaged in explorations on the western coast of Africa, we have now to add these further details. M. le Comte de Semellé who started from Fernando Po in May, 1878, to explore the upper Niger and Benué, returned to that settlement on February 13th, last, and has forwarded an account of his discoveries to Europe.

M. Soleillet has also been obliged to return to St. Louis, Senegal from Sego on the Niger, in consequence of the refusal of the Sultan of Sego to allow him to pass through his territory.

The *Athenæum* (April 12, 1878) gives the following astronomical observations taken by M. de Brazza, Okanda's residence amongst the Bateke, 1° 34′ 59″ S., 11° 59′ 48″ E.; Obemba, an

[1] This journal, Feb. 23, 1878 (March number).

[2] Edited by Ellis H. Yarnall, Philadelphia.

Apfuru village, 1° 31′ 40″ S.; deserted spot, 0° 14′ N., 12° 17′ 30″ E.; Nghimi, 1° 37′ 56″ S., 11° 23′ E. The places are in the basin of the Ogowé with the exception of Obemba which is in that of the Congo. Four rivers crossed between 1° 30′ S. and 0° 30′ N. latitude flow eastward. Obemba is on the Alima, a powerful river which was navigated down to 12° 32′. The longitudes are reckoned from Paris.

Turning now to the eastern coast of the "Dark Continent," we find still more to record in the researches and enterprises undertaken both by scientific and religious societies. A survey is being made by the Portuguese for a railroad from the Delagoa bay to the Transvaal. The opening of the road from Dar-es-Salaam to lake Nyassa is progressing favorably. In December forty miles of the route had been traced out and no serious difficulties encountered. The dreaded tsetse-fly does not prevail in this region and bullocks and donkeys were employed in the work. Mr. Keith Johnston and his companion Mr. Thomson arrived at Zanzibar on the 5th of January. During a short detention at Aden the latter made an exploratory trip to Somali-land and he has sent a paper to the Royal Geographical Society containing an account of the region and its inhabitants, and of the geology and physical geography of the neighborhood. Mr. Johnston has engaged Chuma, Livingstone's favorite attendant, as headman in the journey to Nyassa. Since the death of his old master, Chuma has had much experience of travel in the country east of Nyassa.

For recent additions to our knowledge of that lake and its surroundings we are indebted to reports in the London *Academy*. It states that at a meeting of the Society of Arts a paper by Mr. Cotterill "On the Opening out of the Districts to the North of Lake Nyassa," was read, in which this country, walled in by the great Kondi mountains—believed to be more than 12,000 feet high—is spoken of as among the most beautiful and fertile tracts in Africa. Only among the Himalayas is scenery found at all comparable to that of the Kondi country. Mr. Johnston is especially instructed to examine this range of mountains thoroughly, their elevation, extent, the passes through them, etc. It constitutes the water-parting of the Rufiji and Nyassa systems. The *Academy* also notices a paper by Dr. James Stewart, read before the Royal Geographical Society, "On the Second Circumnavigation of lake Nyassa." The effect of this more recent survey (made September, 1877) is to shift the position of the lake twenty-four miles further west. Gold was discovered in the vicinity of Mount Waller which is 4,000 feet above the level of the lake. At the northern extremity of the lake a river called the Rombushe flowing into the lake was discovered.

It is now possible to steam over the 350 miles comprising the length of the Nyassa in forty or fifty hours, and, excepting a gap about seventy miles in length where cataracts intervene, to sail

from the London docks to the north end of the lake by way of the Zambesi and Shiré rivers.

Accounts of the progress of the exploration making on the western side of the Nyassa by the Missionaries from Livingstonia down to October 30, 1878, have been received in Scotland. The party left Livingstonia on August 12, 1878, and journeying first in a south-westerly direction, reached a mountain plateau some 4500 or 5000 feet above the sea-level. They then traveled through an open country, well watered, with a soil composed of disintegrated granite. Turning northwards they struck across the river Lintippe westwards and traveled for some time through a deserted but once populous country, Finally they reached Chivere's country, which is open, well watered and populous, but entirely devoid of trees. Reaching the coast south of the lake Chia they proceeded north along the coast and when last heard from had reached Kuta bay—Bandepe on Livingstone's map.

The *Nature* states that the exact position of Blantyre, which lies to the east of the Murchison Falls on the Shiré, and was never before accurately ascertained, has been found to be S. lat. 15° 45′ 25″ and E. long. 35° 14′ 11″.

Ill fortune has continued to attend the Belgian African Expedition. Lieut. Wauthier died of dysentery on the 19th of December last, near lake Chaia, a small body of water some eighty miles south-east of Tabora in Unyanyenbe. Dr. Dutrieux was with him at his death, but the remaining chief, M. Cambier, when last heard from, had passed Tabora on the road to Mœne, M. Dutalis has arrived at Zanzibar and will hereafter command the expedition. Mr. H. M. Stanley accompanies him and will act as guide and interpreter. Capt. Popelin will also soon leave Belgium to execute the plan of forming a chain of stations across Central Africa from Zanzibar to the Loango coast. The means for this important undertaking are supplied by the King of the Belgians.

Another Missionary of the (English) Church Mission to the Victoria Nyanza, Mr. Penrose, has met with a violent death at the hands of the natives. He was on his way to the Nyanza and was attacked and murdered at nearly the same time as the death of Lieut. Wauthier occurred and near the same lake Chaia. It is stated that the attack was made in revenge by marauders who had been previously defeated by the Abbé Debaize of the French Scientific Expedition. Letters have been received from the latter, in Paris, dated October 17, 1878, near Tabora, the capital of Unyamalzi. He had so far been most successful, having accomplished his march with great rapidity, without loss either in men, supplies, or instruments, and was in perfect health. He states that the power of the Arabs wanes daily, and their place is being taken by the English. The power of the Sultan of Zanzibar is merely nominal. The Sultan reigns but the English Consul gov-

erns. Two of the French missionaries from Algeria have died, one of them by illness and the other having been killed by a lion. Letters down to October 17, 1878 have been received by the London Missionary Society from their mission at Ujiji on lake Tanganyika. The death from apoplexy of the leader of the party, Rev. Mr. Thomson, is announced. The Arabs report the grass in the Lukuga (Cameron's supposed outlet of the lake) as having been swept away in the last rainy season by the rising of the lake waters. They say it is now an out-flowing river, and one of them had gone down it to the Kamolondo (?) lake.

We learn from the *Nature* that a German Scientific Expedition under Herr C. Denhardt has recently explored the course of the river Dana They only advanced about sixty miles into the interior. They could hear nothing of Mount Kinea, and it is probable the stream does not take its rise from its slopes as hitherto supposed.

Mr. Mackay of the English Church Missionary Society reached the south-eastern shores of the Victoria Nyanza at Kagei in July, 1878. Having received a conciliatory message from Lukongeh, chief of the Ukerewe, by whom his colleagues, Messrs. Smith and O'Neill were killed, he visited him. Lukongeh stated he had no quarrel with white men and that the death of his friends was caused by their interference in the affairs of an Arab. On his return to Kagei Mr. Mackay met the Rev. Mr. Wilson, who had crossed over from Uganda and the two returned together to King Mtesa's, after Mr. Mackay had succeeded in putting together the sections of a small steamer in which he transported across the lake the stores of machinery, tools and useful articles sent out for the instruction of the natives. The British Government has been informed of Mtesa's intention to send an embassy to the Queen. He is anxious to open up a direct road from the Nyanza to the coast through the Masai country. He is ready to welcome Englishmen, but desires no more dealings with the Arabs, and is very much afraid of the Egyptians. Rumanika, the old King of Karagwe is dead, and Mtesa has dispatched an army to secure the throne for one of the deceased king's sons.

The Missionaries sent out by the Society by the Nile route arrived at Regiaf above Gondokoro about November 7th.

At a conference of telegraph engineers and others held at the Royal Geographical Society's rooms in London, on the 6th of January, last, a report was adopted recommending a route for an overland telegraph from Khartum to Pretoria. The following are the sections and distances on this route:

	Geographical Miles.
1. Khartum to Gondokoro	645
2. Gondokovo to Mtesa's capital	300
3. Mtesa's to south side of Lake Victoria	300
4. Lake Victoria to Unyanyembe	130
5. Unyanyembe to Bagomoyo	370

	Geographical Miles.
5*a*. Bagomoyo to Zanzibar	35
6. Bagomoyo to north of Lake Nyassa	290
7. Down Lake Nyassa to Livingstonia	300
8. Livingstonia to Tete	145
9. Tete to Pretoria	820
	3335
To which must be added for deviations, say about one-fifth, viz:	667
Making in all	4002

The practicability of making and keeping open such a line is asserted by Capt. Cameron, Mr. H. M. Stanley, Mr. Ziegler, Director of the London and Red Sea Coast Telegraphs, Sir. F. Goldsmid, of the overland Indian Telegraph, and others. Meanwhile the British Government has decided to lay a cable from Aden to Zanzibar, thence to Port Natal via Mozambique and Delagoa bay. Madagascar and the Mauritius may also be connected with this line.

MICROSCOPY.[1]

American Society of Microscopists.—This Society, which was the outgrowth of the Microscopical Congress at Indianapolis, last summer, is making arrangements to meet at Buffalo on Tuesday morning, August 19th, with the probability that its sessions will continue until Friday night the 22d. This will leave ample time for those who wish to attend also the meeting of the American Association for the Advancement of Science, at Saratoga, on the 27th of the same month. The people of Buffalo have organized a local committee, with sub-committees on finance, on transportation, on accommodations and rooms, on entertainments, and on microscopical soirée. The place for headquarters of the Society, and for holding the meetings, has not yet been finally decided upon, but will soon be announced. Arrangements are being made with great care and consideration, and those who remember the superb reception given in that city to the A. A. A. S. a few years ago, will need no assurance that the meeting will be made pleasant as well as profitable.

National Committee on Micrometry.—This committee, in the formation of which most of the active microscopical societies of the country have taken part, has been organized with the following officers and members: F. A. P. Barnard, LL.D., president of Columbia College, N. Y. city, chairman; R. H. Ward, M.D., Troy, N.Y., secretary; George E. Fell, C.E., Buffalo, N.Y.; Henry Jameson, M.D., Indianapolis, Indiana; Prof. S. A. Lattimore, Rochester, N.Y.; Prof. Edward W. Morley, Hudson, Ohio; Joseph G. Richardson, M.D., Philadelphia, Pa.; Prof. Stephen P. Sharples, Boston, Mass.; Prof. H. L. Smith, Geneva, N.Y.; Prof. Albert H. Tuttle, Columbus, Ohio; J. J. Woodward, M.D., Wash-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

ington, D.C.; Lester Curtis, M. D., Chicago, Ill.; the San Francisco society is represented on the committee, though not yet by a western man. The committee is already engaged in discussion of the large number of reports and letters that have been received on the subject.

LEAD CELLS.—Cells may be made readily, and at small expense, from the thin sheets of lead with which tea boxes are ordinarily lined. This material may be obtained from any grocer, and is prepared expeditiously by the following method: It should be smoothed by rubbing and slightly moistened with water, so that when placed upon a turn table it will adhere sufficiently to be marked with a lead pencil. Using thin glass covers as patterns concentric rings may be traced and then removed by means of the sharp point of a penknife. The rings thus formed may be fixed upon the slide with cement, and the depth of the cell increased by placing several of these upon each other, allowing a sufficient interval for partial drying. Shallow cells in particular are formed with the greatest ease by this method, and they seem to be durable.—*M. A. Veeder, Lyons, N. Y.*

[Cells of paper or cardboard are made with great success in the same way, on the modern turntables. Tin or lead cells are generally attached to the slide with Kill's cement or shellac varnish. —ED.]

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SCIENTIFIC NEWS.

— The National Academy of Sciences, held its spring session in Washington, commencing April 15th. A number of important papers were read, and election for officers was held. This resulted in the election of Prof. Wm. B. Rogers, of Boston, as president, and Prof. O. C. Marsh as vice-president; Prof. J. H. C. Coffin, home secretary; Prof. F. A. P. Barnard, foreign secretary; Fairman Rogers, treasurer; Professors Baird, Agassiz, Newcomb, W. Gibbs and A. Hall, and General M. C. Meigs, members of council. The new members of the Academy elected at this meeting are Prof. Cleveland Abbe, distinguished for his researches in meteorology; Prof. J. W. Farlow, botanist, of Harvard University; Dr. Horatio C. Wood, of Philadelphia, prominent in biology; and Prof. J. Willard Gibbs, of New Haven, a student of mathematical physics. The following are among the papers read: S. H. Scudder, The Palæozoic cockroaches; S. Weir Mitchell, The relations of neuralgic pains to storms and to the earth's magnetism; Joseph LeConte, On the extinct volcanoes about Lake Mono, and their relations to the glacial drift; E. D. Cope, On the extinct species of the rhinoceros and allied forms, of North America; E. W. Hilgard, The loess of the Mississippi and the æolian hypothesis; G. K. Gilbert, On the stability and instability of drainage lines; C. V. Riley, The hybernations and migrations of *Aletia argillacea* (the parent of the cotton worm); A. Agassiz, Report on dredgings in

the Carribean sea by the U. S. Coast Survey steamer *Blake*, Commander John R. Bartlette, U. S. Navy, commanding; G. J. Brush, On a mineral locality in Fairfield county, Connecticut; J. S. Newberry, On the great silver deposits recently discovered in Colorado, Utah and Nevada.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Feb. 11.—The President, Dr. Ruschenberger read an extract from a letter from Dr. Siegfried, U.S.N., descriptive of the aborigines of the island of Botel Tobago. Rev. H. C. McCook gave an account of his studies upon the habits of leaf-cutting ants of Texas.

Feb. 18.—The President in the Chair. A paper entitled, On the structure of the Chimpanzee, by Dr. H. C. Chapman was presented for publication. Dr. Leidy exhibited some specimens of *Bothriocephalus latus* which had been obtained from a Swedish woman, this tape-worm appeared to be very rare in this country, being the first he had ever seen. Dr. Leidy also gave the results of his examination of the second chimpanzee, which recently died at the Zoölogical Garden, stating that in this specimen the cerebrum fairly covered the cerebellum; longitudinal *valvulæ conniventes* were found in the middle of the small intestine, and forty-five Peyer's patches were counted. The development of the laryngeal pouch was also considered.

NEW YORK ACADEMY OF SCIENCES, April 7. — Prof. J. S. Newberry read a paper on the occurrence of gold with the silver ores of Nevada.

April 21. — Prof. Arnold Guyot presented a paper on the topography of the Catskills.

April 28.—Prof. J. S. Newberry remarked on the devices employed in nature for the distribution of the seeds of plants.

BOSTON SOCIETY OF NATURAL HISTORY, April 16. — Dr. S. Kneeland spoke on the mineralized phosphatic guanos of the Pacific islands.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—April. Observations on the structure of cells and nuclei, by E. Klein. On the apical and oral systems of the Echinodermata, by P. H. Carpenter. The development of the earth-worm, by N. Kleinenberg (shows that the brain is formed independently of the ventral nervous cord, and criticises Semper's views as to the derivation of the nervous system of vertebrates from that of worms). The Nematoid Hæmatozoa of man, by T. R. Lewis (confirms Manson's discovery of the migration of a human hæmatozoön from the blood of a mosquito, and records the life-history of the *Filaria sanguinis-hominis*).